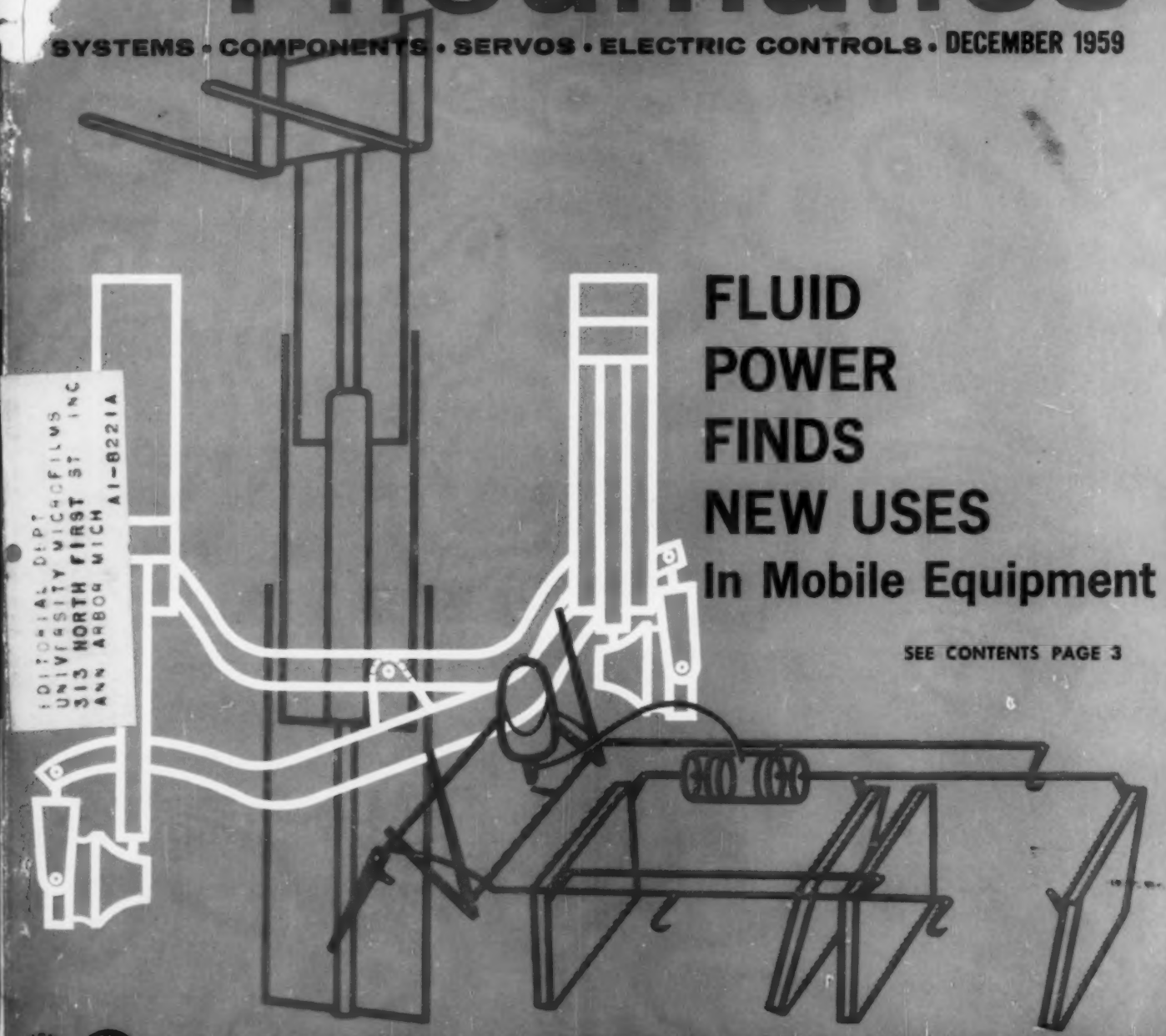
APPLIED Hydraulics & Pneumatics

SYSTEMS • COMPONENTS • SERVOS • ELECTRIC CONTROLS • DECEMBER 1959



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FLUID POWER FINDS NEW USES In Mobile Equipment

SEE CONTENTS PAGE 3

THE MAGAZINE OF FLUID POWER

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As easy as plugging in your electric shaver...

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FLUID LINE
CONNECTION
or
DISCONNECTION

with
INSTANT
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or
SHUT-OFF

HANSEN

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TWO-WAY SHUT-OFF
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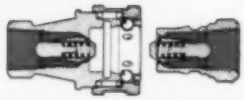

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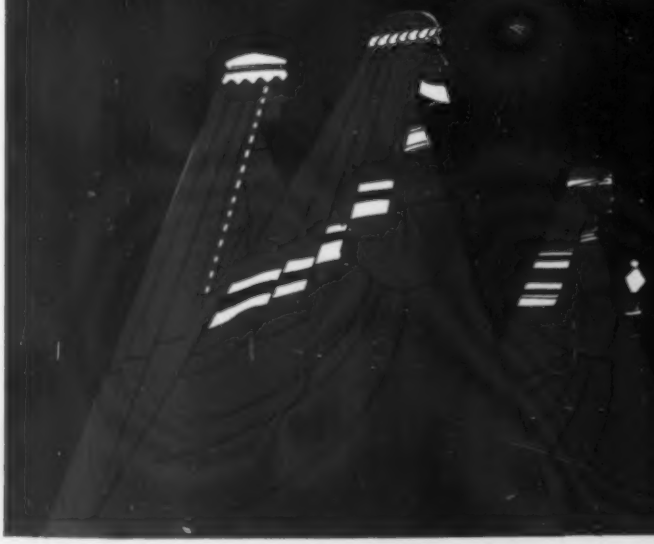

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APPLIED
Hydraulics & Pneumatics®

VOLUME 12/NUMBER 12

DECEMBER 1959

THE MAGAZINE OF FLUID POWER

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FACTS

and figures on products and literature can be had by circling the right numbers on the time saver cards opposite back cover.

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BPA

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For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants, all types of Fire-resistant Hydraulic Fluids and Water.

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CONNECTIONS:
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BY-PASS VALVE:
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For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants, all types of Fire-resistant Hydraulic Fluids and Water.

Bonded LINE TYPE

CAPACITIES:
10—20—30—50 and 75 G.P.M.

PIPE SIZES:
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BY-PASS VALVE:
Available with or without.

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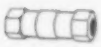
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HYDRAULICS CORPORATION

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APPLIED Hydraulics & Pneumatics

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Published monthly. Accepted as controlled circulation publication at Pontiac, Illinois. Please return 3579 forms to 812 Huron Road, Cleveland 15, Ohio.

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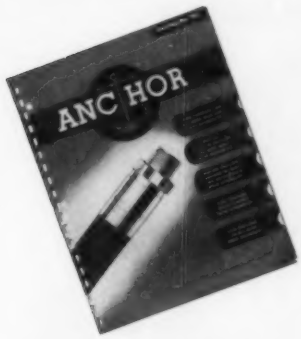
USEFUL LITERATURE

ANCHOR ISSUES NEW HYDRAULIC HOSE ASSEMBLY CATALOG

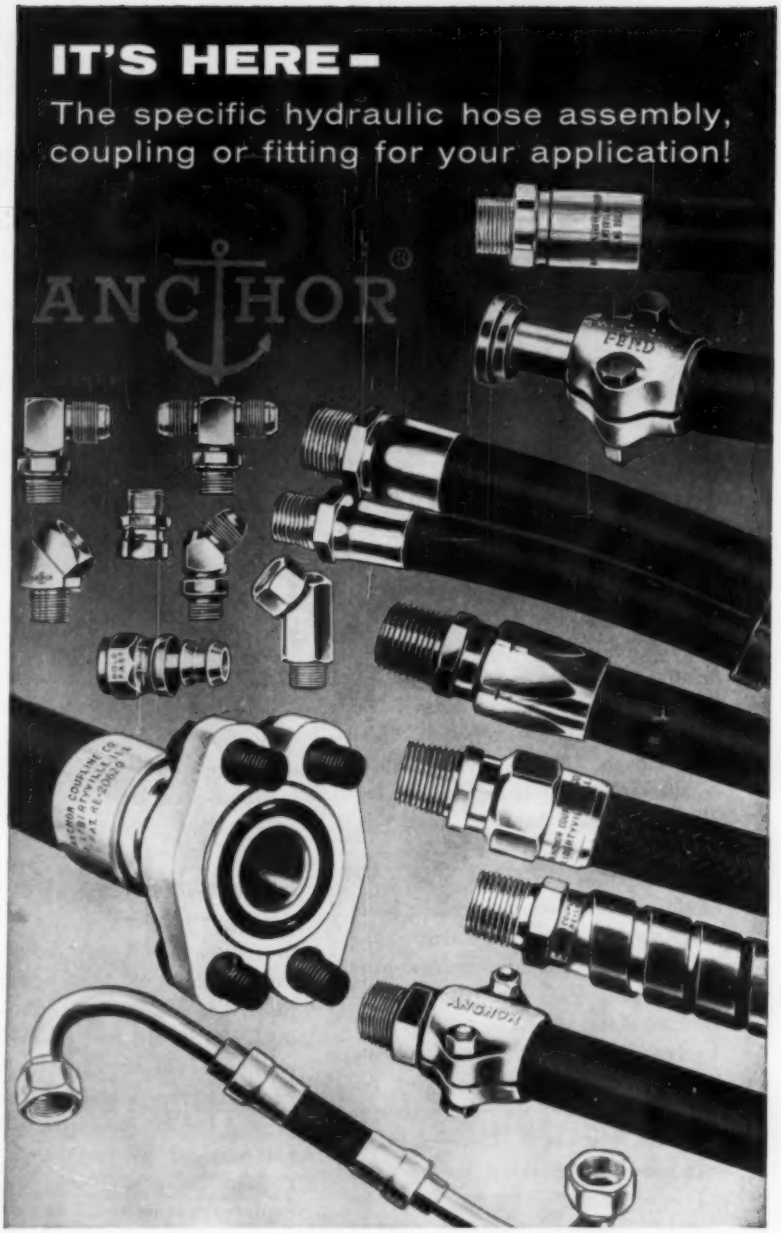


The new Anchor Catalog No. 102, just issued, will be of intense interest to all manufacturers using fluid power for their equipment, or transmitting fluids at high pressures. This new catalog is an expanded, revised and enlarged edition of the former Anchor Hose Assembly Catalog No. 101.

Included for the first time are hose assemblies made from Anchor's new Super-Spiral 4-ply and 6-ply Spiral Wire Reinforced Hydraulic Hose for very high pressures. This new hose opens the way for the use of higher pressures in hydraulic equipment, a long sought objective for many hydraulic engineers. The new hose is made available in assemblies of 3/16" to 2" inside diameter, for recommended working pressures ranging from 12,000 PSI for the 3/16" ID 6-ply hose to 2000 PSI for the 2" ID 4-ply hose. The assemblies can be equipped with several different styles of pressed-on coupling, including "O" ring flanged head straight and angle couplings. All other high, medium and low pressure assemblies included in the broad Anchor line are fully described.

The catalog also includes helpful engineering data and other information of value to hydraulic engineers.

Copies of this new Anchor Catalog No. 102 may be procured by writing Anchor Coupling Co., Inc., 372 N. Fourth St., Libertyville, Illinois.



Write For Anchor Catalog No. 595

When you have a problem in fluid power transmission, it's a safe bet that you can find its solution in an Anchor catalog. If not there, consultation with Anchor's engineers, with all their years of hydraulic experience, will be sure to bring the right answer.

We cannot say that the Anchor Line of hose assemblies, couplings and fittings is complete because it never will be. But we like to boast that if Anchor doesn't make it, it isn't being made!

And you can be sure that if it carries an Anchor trade mark—the quality and workmanship is of the highest.

ANCHOR COUPLING CO. INC.

371 No. Fourth St., Libertyville, Ill.
Branch Plants: Dallas, Texas; Plymouth, Mich.

FLUID POWER LINES

about hydraulics & pneumatics

MOBILE EQUIPMENT, THE RACE FOR ROADS . . . Americans like to travel. They like good automobiles, and they want good roads to drive them on. They also like attractive homes, well landscaped, and comfortable office buildings and factories in which to work. These mean business to the manufacturer of bulldozers, shovels, scrapers, backhoes, cranes, graders, rollers, and all the other machines that dig, haul, lift, and push.

Fluid power is an important part of almost every powered vehicle, from space probes to garbage trucks. So it's one of the tools the engineer-production-sales team has, to beat competition. Like all products, how well hydraulic and pneumatic systems work and how much they cost depends on how well they are designed. The designer has a choice of many components engineered for his type of equipment. Only rarely is he forced to design a special or modify a standard design.

This issue concentrates on components for mobile equipment and how they are used. The articles describe basic technology (*Selecting Flexible Hose for Hydraulic Systems*) and they also emphasize new applications (*Stored Energy Closes Coal Car Doors*). They can help you design better products, because in the race for bigger, faster, cheaper mobile equipment, fluid power design is a front runner.

HOSE FOR ALL IT'S WORTH . . . No component is more common or more critical than flexible hose in mobile equipment hydraulic systems. Because pressures are going up, to get components smaller, hose manufacturers have stepped up their efforts to bring out high pressure, flexible hose. In his article on page 70, Wendell Fentress gives a summary of what's available and what's coming. A research engineer as well as an executive, Fentress has participated in many research and development projects which have produced new products and processes. He holds more than 25 patents.

Fentress

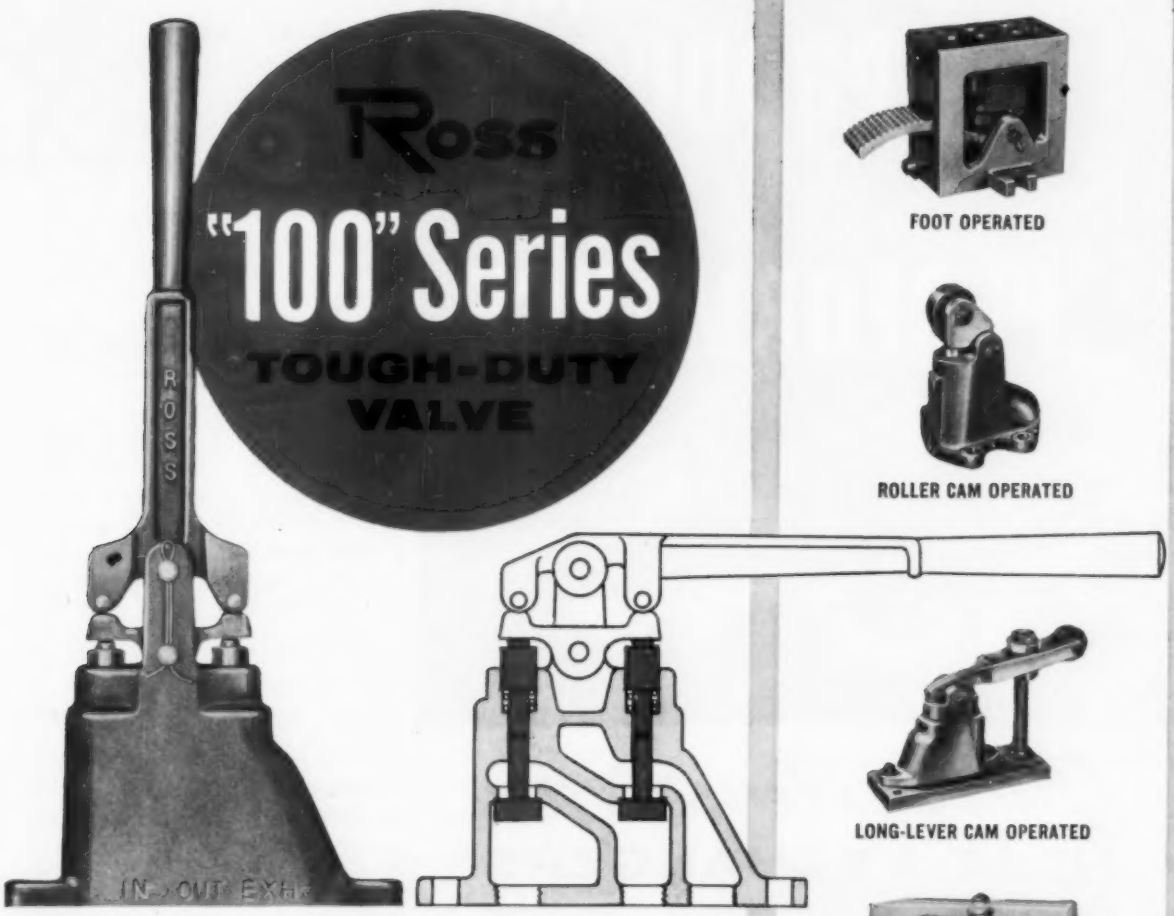
OPEN THE DOOR! . . . When that command is given in the Nike launch procedure, Bob King's design goes into action. What happens is described in his article *Nike's Underground Launching System*. His responsibilities in charge of hydraulic lifts and other equipment have given him the background for the Nike design. An electrical engineer by training at Tri-State College, Bob's past work as a control engineer was in hydraulics and electrical systems.

King

MORE CYLINDER SYNCHRONIZING . . . Adding still another design to keep cylinders moving together, Jay Roth, author of *Master-Slave System Synchronizes Telescoping Cylinders*, shows a simple method. Plenty of past experience went into the special cylinders for this design. After serving with the Army Air Corps in pump development, Jay joined Pesco Products where he became Director of Engineering and was co-inventor of the first hydraulic pump for —40 F operation. He formed his own company in 1946 and now manufactures hydraulic components for material handling equipment.

Roth

Give this valve your *ROUGHEST* jobs!



foot, cam, solenoid versions available, too

FOOT OPERATED

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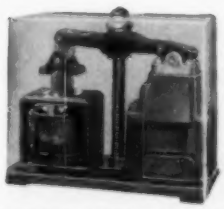

SOLENOID DIRECT OPERATED

Steel mills, foundries, mines, offshore drilling, logging . . . these industries love the Ross "100" Series valve. Here's why: It performs well wherever you need a manually operated valve, but it is really the finest, most dependable valve available for use where the environment is rough and tough. The "100" Series valve will pass most dirt and foreign matter with no trouble and has only a few moving parts. Its poppets travel only a scant fraction of an inch, so it is especially wear resistant. It transmits a "feel" of control to the operator so he may "inch" a cylinder with fine control. Available in locking or non-locking, 3 way or 4 way, closed or cracked-to-exhaust-center models, with handle normally upright or horizontal. Write for further information.

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LETTERS to the editor

Address your letters to: Editor, APPLIED HYDRAULICS & PNEUMATICS MAGAZINE, 812 Huron Rd., Cleveland 15, Ohio.

Need reed seals

TO THE EDITOR:

We are interested in contacting a manufacturer of metallic reed seals for use in high temperature components. We would also like to have a bibliography of published literature on high temperature hydraulic sealing problems and the use of metallic seals.

Any information on this subject that you may be able to provide will be much appreciated.

T. A. O'CONNOR
Electro-Mechanical Hydraulics
Lear, Inc.
Grand Rapids, Mich.

We haven't been able to locate a manufacturer offering metallic reed seals for sale. As you may know, several of the airplane manufacturers have worked on metallic seals, including Autonetics Div. of North American, Chance Vought, and Boeing. As far as we know, none of them has a reed seal in production.

An October '58 article, "Aircraft Reliability Demands Leakproof Hydraulics" describes several advance type seals which may be of interest to you. An article which we are planning to publish deals with a Boeing design for a ring-spring metallic seal.

Hydraulic system maintenance

TO THE EDITOR:

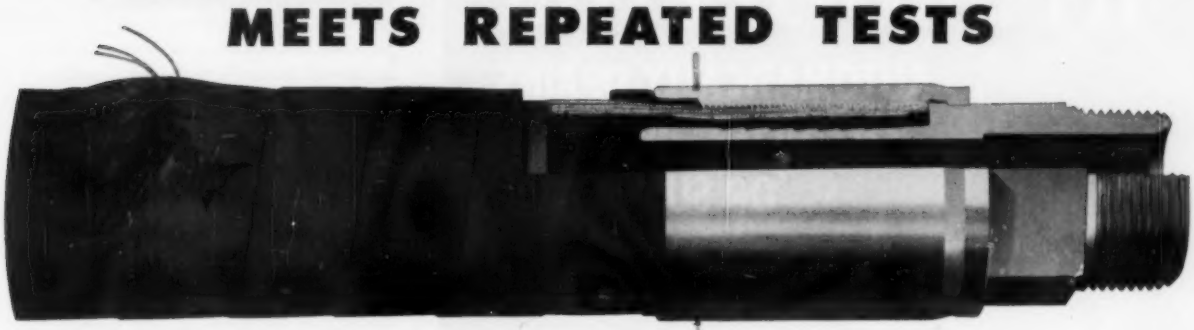
Do you have any reprints of articles dealing with breakdowns in hydraulic systems. It may deal with practices and accessories that prevent such breakdowns.

ZUCE KOGAN
Zuce Kogan Engineers
Chicago, Illinois

A reprint of our article concerning temperature control problems of the fluid power system will be of value to you. Much of the in-

Continued on page 12

Eastman APPLICATION MEETS REPEATED TESTS



Tests prove that Eastman couplings applied to super high pressure 4-ply spiral wire hose assure successful assemblies. Couplings hold well above minimum burst pressure.

PERMANENTLY ATTACHED COUPLINGS PROVIDE BOND STRONGER THAN HOSE ITSELF!

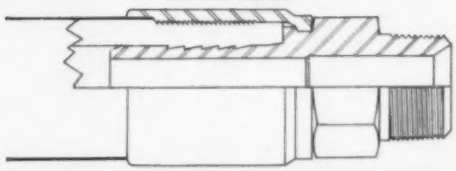
Increasing demand for greater power brought about the use of higher pressures in hydraulic systems. This not only calls for greater hose strength, but far more critical engineering in coupling design and application.

EASTMAN is contributing toward the development of the trend toward higher pressures—not only in the design and application of coupling to hose—but in the more exhaustive tests required to assure adequate safety under high pressure operations.

The actual photo above is typical of many tests in Eastman laboratories proving that the hose did not fail at the coupling—demonstrating that the coupling was designed and applied to form *a bond which was stronger than the hose itself.*

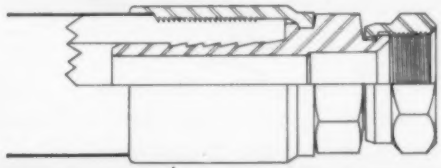
If you have an application requiring higher pressures, let our engineering department demonstrate the superiority and economy of Eastman applications, and quote on complete Hydraulic Hose Assemblies.

MALE NPTF



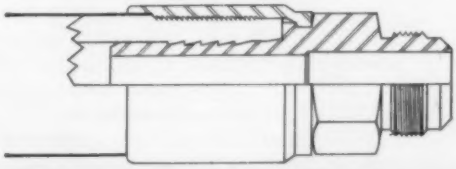
Catalog No.	Hose I.D.	Hose O.D.	Coupling I.D.	Min. Burst Pressure (P.S.I.)	Max. Wkg. Pressure (P.S.I.)
	(inches)				
8412-12M	¾	1 7/16	19/32	20,000	5,000
8416-16M	1	1 ¾	25/32	16,000	4,000
8420-20M	1 ¼	2	1 ¼	12,000	3,000
8424-24M	1 ½	2 ¼	1 31/64	10,000	2,500

SWIVEL FEMALE JIC-37°



Catalog No.	Hose I.D.	Hose O.D.	Coupling I.D.	Min. Burst Pressure (P.S.I.)	Max. Wkg. Pressure (P.S.I.)
	(inches)				
8412-12FH	¾	1 7/16	19/32	20,000	5,000
8416-16FH	1	1 ¾	25/32	16,000	4,000
8420-20FH	1 ¼	2	1 ¼	12,000	3,000
8424-24FH	1 ½	2 ¼	1 31/64	10,000	2,500

MALE JIC-37°



Catalog No.	Hose I.D.	Hose O.D.	Coupling I.D.	Min. Burst Pressure (P.S.I.)	Max. Wkg. Pressure (P.S.I.)
	(inches)				
8412-12MH	¾	1 7/16	19/32	20,000	5,000
8416-16MH	1	1 ¾	25/32	16,000	4,000
8420-20MH	1 ¼	2	1 ¼	12,000	3,000
8424-24MH	1 ½	2 ¼	1 31/64	10,000	2,500

Eastman
first in the field
MANUFACTURING COMPANY
Dept. AH-12
MANITOWOC, WISCONSIN

WRITE today for your copies —

Technical Bulletin 100—Medium Pressure Hose and Tube Assemblies, Couplings and Fittings for One Wire Braid Hose.

Technical Bulletin 200—High Pressure Hose and Tube Assemblies, Couplings and Fittings for Multiple Wire Braid Hose.

HYDRO-JECTOR

AUTOMATICALLY DRAINS ANY FILTER, DRAIN LEG OR SURGE TANK

- GUARANTEED minimum 1 year trouble-free operation
- ½" internal discharge port
- Connecting Nipple available in 3 sizes
- Discharges at rate greater than 300 gallons of water per hour at 125 PSI
- Drains oil as well as water
- Transparent *Visi-Bowl* permits visual inspection
- Operates on pulsating, continuous or no flow
- No air loss during dump cycle
- Vent Nipple prevents air lock
- Manual Plunger permits "clean-out" without disassembly

The *M/P Hydro-Jector* can be installed easily and quickly in the bottom drain port of *any* compressed air filter, separator, drain leg, water bottle, surge tank, air receiver tank or other water collecting vessel.

This is not an ordinary float operated trap. The *Hydro-Jector* incorporates unique pilot valving and large internal discharge passages.

Only M/P offers a one year guarantee against clogging.

WRITE TODAY FOR COMPLETE INFORMATION

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For application in the *M/P Down-Stream Circuit*—a new M/P concept which assures reliable lubrication of even the smallest air cylinders.

SHATTER-GUARD
A new feature which makes the *M/P Visi-Bowl* as safe as a metal bowl. Available on all M/P Filters, Lubricators and Hydro-Jectors.

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20430 SHERWOOD • DETROIT 34, MICHIGAN • Phone: TWinbrook 3-7070

Circle **80** on Time-Saver Card

LETTERS

formation contained in this article is aimed towards reducing breakdowns in hydraulic systems.

Air system operation

TO THE EDITOR:

I am making a study of various aspects of compressed air and wonder if you could give me information or leads in the following areas:

1. Uses of compressed air in municipal operations that show versatility of air.
2. Use of pneumatic equipment in maintenance of industrial plant facilities.
3. Maintenance of air distribution equipment (other than the compressor).
4. What a plant engineer should know about compressors.

If you have any spare photos or other illustrations in the above fields, they would be greatly appreciated.

We enjoy your book very much, keep up the good work.

H. F. VAN LEUVEN
Kansas City, Mo.

We have sent our April '58 issue which has a very complete article on selection of air compressors. We also suggest you contact the Compressed Air and Gas Institute in Cleveland.

Requests January Designers Guide

TO THE EDITOR:

During the past eighteen months I have seen a composite listing of hydraulic and pneumatic valve manufacturers and the special types of valves (i.e. check, relief, bleed) each produced. If you recall publishing such a list and could assist me in obtaining a copy, I would be most grateful.

R. C. BARTLETT
Buying Supervisor, Hydraulics Group
Convair Astronautics
San Diego, Calif.

We're sending you a copy of our January Designer's Guide

Continued on page 16

. . . Fluid Power news

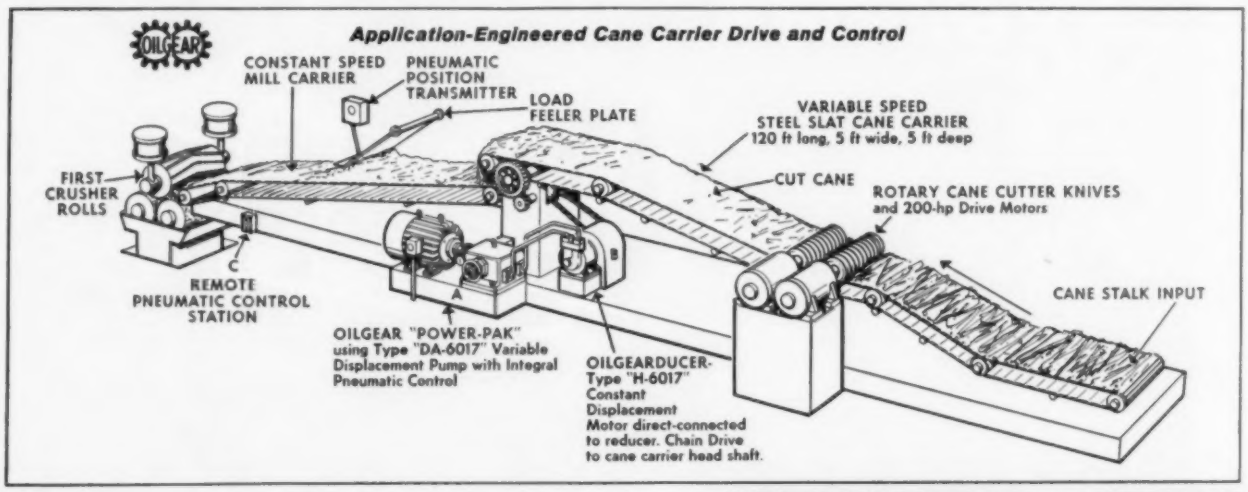
REPORT No. 11,302 "ANY-SPEED" DRIVE UPS MILL EFFICIENCY

From Oilgear Application-Engineering Files

HOW OILGEAR "Any-Speed" DRIVE AND CONTROL SYSTEM AUTOMATED A SUGAR CANE CARRIER

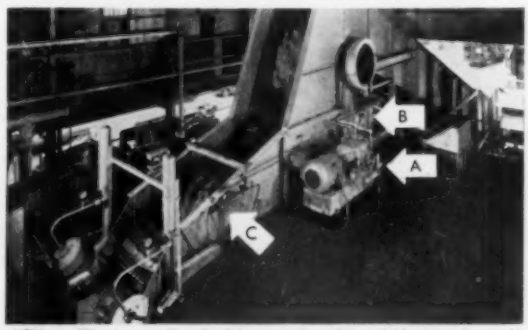
CUSTOMER: A Large Sugar Cane Mill (Name on request).

DATA: To increase mill efficiency, and run at maximum capacity by maintaining an optimum flow of cut cane to the crushers, it was necessary to convert a conventional, manually controlled electric cane carrier drive to an automatic, load-sensitive, variable speed drive and control system with the following specific requirements: 1. An infinitely variable speed drive coupled with automatic "sensing" load-speed controls to exactly match cutter and crusher capacity . . . plus instant-stop overload protection as required by the following variables: 1a. Inconsistent carrier loading. 1b. Varying size and physical characteristics of the cane. 1c. Cut cane's tendency to "choke" or pile up at the crusher. 1d. Gradual efficiency loss as cutter knives become dull. 2. Automatic speed control, and stop, related to load. 3. Remote and manual control to start, stop, inch, and infinitely increase or decrease carrier speed. 4. Pneumatic controls, as mill personnel understand them. 5. Dependable, trouble-free for round-the-clock harvest operation, impervious to high humidity and daily washdowns.


Application-Engineered Cane Carrier Drive and Control
CONSTANT SPEED MILL CARRIER
PNEUMATIC POSITION TRANSMITTER
LOAD FEELER PLATE
VARIABLE SPEED STEEL SLAT CANE CARRIER 120 ft long, 5 ft wide, 5 ft deep
FIRST CRUSHER ROLLS
CUT CANE
ROTARY CANE CUTTER KNIVES and 200-hp Drive Motors
REMOTE PNEUMATIC CONTROL STATION
CANE STALK INPUT
OILGEAR "POWER-PAK" using Type "DA-6017" Variable Displacement Pump with Integral Pneumatic Control
OILGEARDUCER-Type "H-6017" Constant Displacement Motor direct-connected to reducer. Chain Drive to cane carrier head shaft.

SOLUTION: An Oilgear "Any-Speed" Drive and Control System consisting of an Oilgear "Power-Pak," an Oilgearducer, and the pneumatic control system as shown above. This "Power-Pak" uses a Type "DA" Variable Displacement Pump with integral pneumatic control, a constant speed electric motor all mounted on a custom reservoir base. The Oilgearducer consists of an Oilgear Type "H" Constant Displacement Motor direct-connected to a reducer. Operating on a pressure differential of 3 to 15 psi, the integral, pneumatic, pump control system provides stepless, infinitely variable drive speeds from zero to maximum. A completely automatic control system increases or decreases carrier speed in response to preset percentage of knife motor load, and position of the feeler plate on the mill carrier section . . . carrier is instantly stopped by sudden peak overloads on the knife motors, or by raising of the feeler plate above a preset position. Carrier can also be started, stopped, inched, accelerated or decelerated from the remote stations, or with the manual handwheel on the Pump.

OWNER REPORT — after two seasons of operation — ". . . . *we began operations this season on January 9. We have been running under automatic operation since, and the results have been beyond expectations.*"



Right: A view of above installation. Oilgear "Power-Pak" (A), Oilgearducer (B), and one of the Remote Control Stations (C) are indicated.

Some of the "Plus Features" of this, and other Oilgear installations are: cushioned starts, stops, acceleration and deceleration . . . constant pressure and flood lubrication, and system fluid filtration . . . a "sealed" system, impervious to moisture-hazardous atmosphere . . . complete overload protection . . . long-life, trouble-free, efficient performance. Users say — "*for the lowest cost per year — it's Oilgear!*"

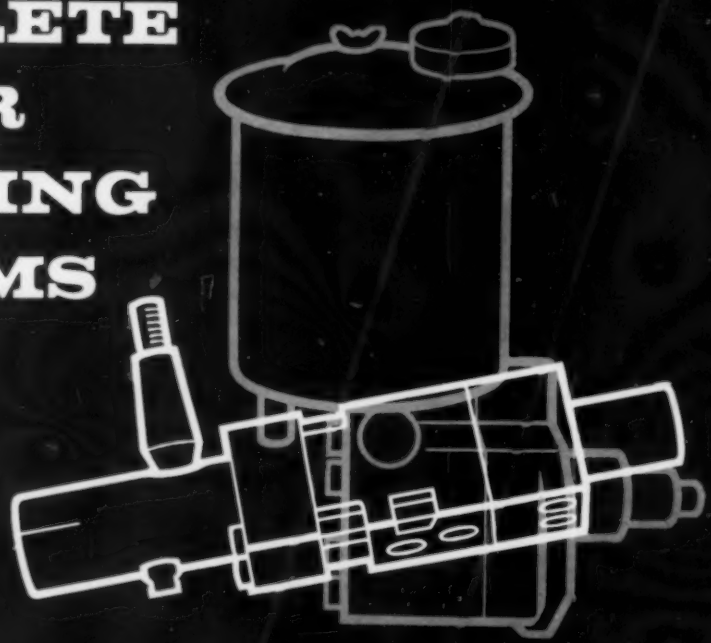
For practical solutions to YOUR linear or rotary Controlled-Motion problems, call the factory-trained Oilgear Application-Engineer in your vicinity. Or write, stating your specific requirements, directly to . . .

THE OILGEAR COMPANY

Application-Engineered Controlled-Motion Systems

1564 WEST PIERCE STREET • MILWAUKEE 4, WISCONSIN

ONLY VICKERS OFFERS NEW AND COMPLETE POWER STEERING SYSTEMS



Complete System Responsibility

VANE PUMPS FOR BEST OPERATION

The Vickers power steering system utilizes vane pumps designed and built to last much longer than other type pumps. Further, they exert virtually no load on the starter like gear pumps do on those cold morning starts.

WORLDWIDE STOCKS AND INTERCHANGEABILITY

If part of your production goes into export, or if you manufacture abroad, consider this: Vickers products are built in plants throughout the free world . . . and all parts from all plants are completely interchangeable. Wherever your equipment is working, there are Vickers parts nearby.

FOR ALL THE DATA . . .

New bulletin gives complete information on this important breakthrough in power steering design and manufacture. It contains dimensions, ratings and other data so you can draw your own comparisons. Write for Bulletin M5110.

For axle loadings from 1,500 lbs. to 128,000 lbs.

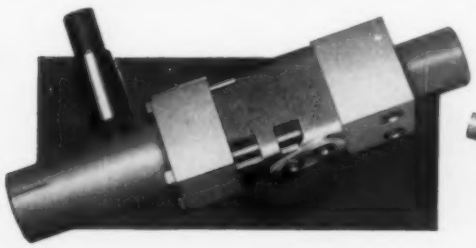
Manufacturers of mobile equipment can now install a completely tailor-made power steering system using standard, production built components. These components are designed to occupy less space because of compact design and high pressure operation (up to 2000 psi). Size for size you get double the thrust for equivalent price.

There are other advantages, too. Your engineering and manufacturing costs are substantially reduced since for all vehicle models you have a matching standard system. Your inventory is reduced because fewer parts are needed and all parts are interchangeable . . . field service is simplified, speeded, too. These parts are all of the same well-engineered construction providing uniform performance and service.

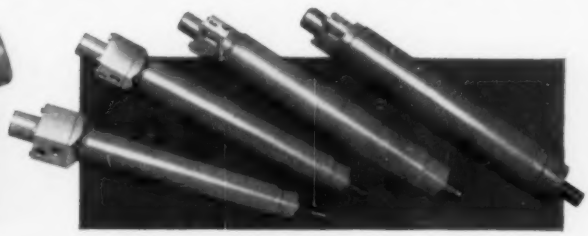
All cylinders are double walled eliminating functional damage to cylinder walls by flying debris, a common hazard.

In addition, when you deal with Vickers you are dealing with a pioneer in power steering . . . a company that maintains a staff of specialists in power steering to serve you. AND, you get the *complete* system from one source . . . Vickers, the name that *makes* the news in fluid power.

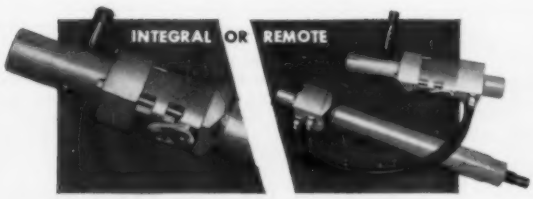
FOR ANY VEHICLE HERE'S HOW SIMPLE IT IS



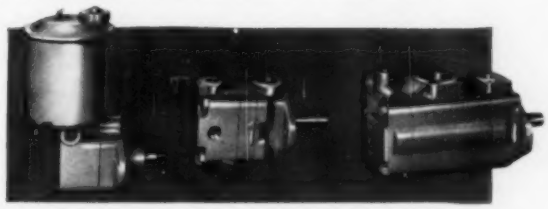
1. You take this **ONE** valve



2. One of **FOUR** cylinders



3. Connect them like this



4. Add one of three pumps

and you have TAILOR-MADE VICKERS® POWER STEERING with STANDARD PRODUCTION-BUILT COMPONENTS

8182

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Mobile Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
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ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

FULFLO

piston-type oil relief by-pass valves for O.E.M. or replacement

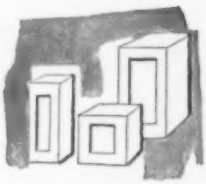
Best Buy because

QUICK DELIVERY

Fulflo stocking policy *and* practice permits quick shipment from stock of most standard types. Shipment is usually made *within 24 hours.*

TECHNICAL SERVICE

Fulflo engineers are ready *and* able to help you with any valve problem. Modified standard or special valves can be provided for any need.



WIDE RANGE OF TYPES AND SIZES

- Standard and flanged models
- Just 6 springs for pressures to 500#
- Wide range of brass, cast iron or steel bodies . . . brass, steel or stainless pistons
- Pipe sizes to 3"
- SPECIALS to your requirements

FREE, completely NEW CATALOG . . . just off the press!

THE FULFLO SPECIALTIES CO., INC.
415 Fancy Ave.—Blanchester, Ohio

Circle **50** on Time-Saver Card

LETTERS

Issue. Next month's edition of this annual product listing will chart specifications for 34 hydraulic and pneumatic components.

Needs lathe servo control

TO THE EDITOR:

Several years ago in one of the trade magazines, I saw an article on the magnetic tape control of a lathe. In the setup shown, the lathe operator made the piece, and the control motions were recorded on tape. Pieces could then be made with the tape—recorded signals directing the lathe. If you know what company makes this servo control mechanism, I would appreciate having their name and address.

R. K. FOWLER
Engineering Dept.
A. J. Wahl, Inc.
Brocton, N. Y.

Names of companies manufacturing numerical control packages and hydraulic components for servo systems have been sent.

***for more information on any product mentioned in our product reviews, useful literature or advertised use the* TIME SAVER CARD.**

The Fluid Power Forum

Each month APPLIED HYDRAULICS & PNEUMATICS surveys readers for their experiences and opinions in fluid power design.

● *Where do you install filters in hydraulic systems? Have you used high pressure filters in the pump outlet line? Do they have advantages in your designs?*

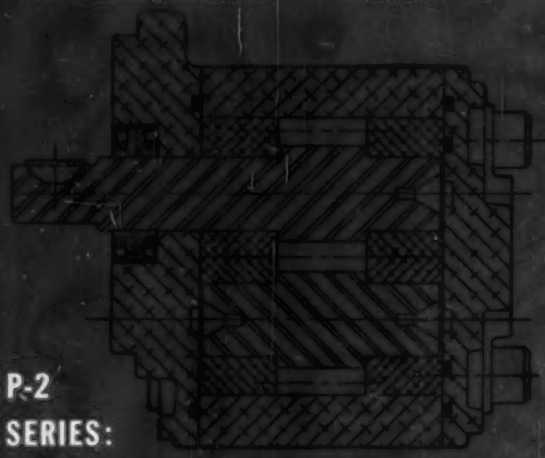
We have been replacing all sump type filters with in-line types. By installing them in parallel with shut-off valves on either side of the filter, we can service each machine without disturbing the operation. This permits regularly scheduled inspections with no machine downtime for filter maintenance.

ROBERT W. PROPHET
Simonds Abrasive Co.
Philadelphia, Pa.

From WOOSTER Engineering...

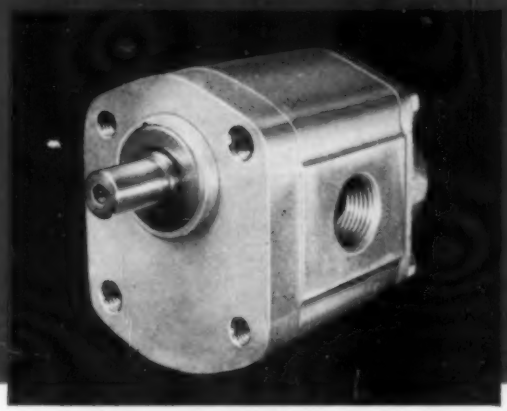
A NEW FAMILY OF B-W HYDRAULIC GEAR PUMPS

- GREATLY SIMPLIFIED
- LONGER LIFE
- HIGHER PERFORMANCE

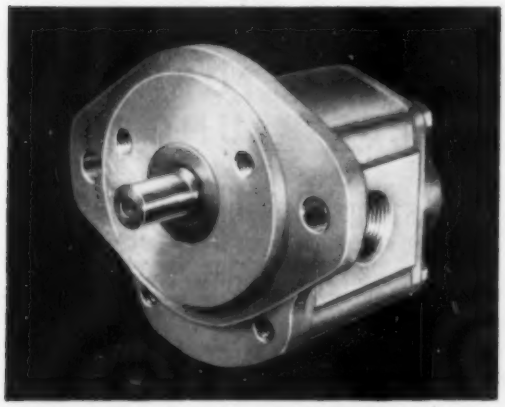


P-2 SERIES:

Capacities 1.7 to 7.8 GPM at 2000 RPM
Displacement 0.2 to 0.9 cu. in.
Pressure 2000 PSI
Speeds to 4000 RPM



Series P-2 Pump has finished its test runs with flying colors. Other series will move oil at a fraction of a gallon per minute to more than 100 GPM.



Series P-2 Pump with standard S.A.E. 2-bolt magneto mounting.

The Most Efficient Hydraulic Gear Pumps Ever Produced by Wooster Engineers

"Designed and built by Wooster" has always meant the BEST. Borg-Warner pumps and valves have been used in an endless variety of applications throughout industry.

But this new pump gives outstanding performance. Pressure from the outlet port is used to reduce clearance between bearing faces and gears, giving optimum volumetric efficiency. New features: Special alloy tin-aluminum bearings, used in the heaviest-duty industrial engines . . . all bearings interchangeable . . . double lip shaft seal . . . hardened and ground steel gears and shafts . . . high quality, high tensile aluminum bodies for light weight.

A Variety of Porting, Mounting and Drive Arrangements To Serve Your Needs—Consult Our Engineers

WOOSTER B-W DIVISION

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BORG-WARNER CORPORATION, WOOSTER, OHIO

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another special from ACIPCO

ERIE FOUNDRY CO. PICKS ACIPCO TUBING FOR CARBON EXTRUSION PRESS PLUNGER

You're looking at a new 2000-ton horizontal carbon extrusion press manufactured by the Erie Foundry Company's hydraulic press division. Designed for the production of carbon electrodes, the press features ACIPCO centrifugally spun steel tubing in its main ram plunger.

Custom-spun by ACIPCO, the plunger is 30.50" O.D. with 125 micro-inch finish and 2-5/8" wall thickness. Main ram is 42" in diameter and has a 105" stroke. Produced with heads statically cast at ACIPCO, the plunger's overall length is 144".

Fabricated applications such as this are a specialty with ACIPCO. Completely equipped to solve a wide variety of tubing problems, ACIPCO can serve your needs more efficiently and economically because all its facilities are under one roof. For expert consultation on centrifugally spun tube applications in your field . . . call on ACIPCO.

VERSATILE ACIPCO CENTRIFUGALLY SPUN STEEL TUBES

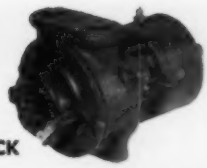
SIZE RANGE: Lengths up to 410" to meet modern machinery requirements have been produced. OD's from 2.25" to 50"; wall thicknesses from .25 to 4".

ANALYSES: All alloy grades in steel and cast iron, including heat and corrosion resistant stainless steel, plain carbon steel and special non-standard analyses.

FURNISHED: As cast, rough machined, or finished machined, including honing. Complete welding and machine shop facilities for fabrication.

SPECIAL PRODUCTS DIVISION
AMERICAN CAST IRON PIPE CO.
BIRMINGHAM 2, ALABAMA

POWERMITE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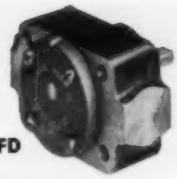
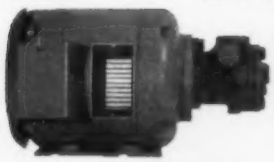
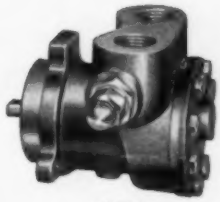

LFD

RCSA

For your pump problems . . . over 800 different TUTHILL pumps

SERIES 42




LPFV

- **Capacities to 200 GPM: pressures to 1500 PSI**
- **For lubrication, coolant, oil burning, circulating, and hydraulic applications**

For over 30 years the Tuthill Pump Company has been meeting the pump needs of American industry. In literally thousands of demanding applications . . . in lubrication, hydraulics, oil transfer and a wide variety of other services . . . Tuthill pumps are providing the dependable, trouble-free performance which has made them an industry standard.

With over 800 different models Tuthill provides a wide selection. Skilled application engineers, especially trained to "fit the pump to the problem", provide valuable design assistance in precisely meeting your pump requirements.

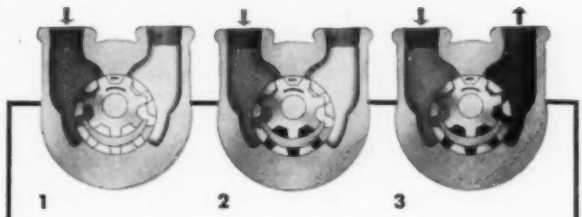
Most Tuthill units employ the time-tested internal gear operating principles described at the right. The complete Tuthill line also includes internal spur gear and sliding vane models.

Many options and modifications

Tuthill pumps can be furnished to fit the requirements of your particular application. For example they can be supplied:

- With or without built-in relief valve
- With automatic reversing feature where pump must be driven from a reversing shaft . . . or a machine must be shipped without knowing ultimate direction of driving unit
- As stripped models to be built into your equipment
- With a wide variety of porting arrangements
- With special shaft seals for various applications
- With provisions for steam jacketing
- With many shaft modifications for drive connections

In short, if your specifications lie within 200 GPM capacity, pressures to 1500 PSI, and speeds to 3600 RPM, Tuthill probably has the answer.



Internal gear pumping principle

In Tuthill internal gear pumps there are only two moving parts. The principle is based on the use of a rotor, idler gear and a crescent shape partition cast integral with the cover.

Power applied to the rotor is transmitted to the idler gear with which it meshes. The space between the outside diameter of the idler and the outside diameter of the rotor is sealed by the crescent. As the pump starts the teeth come out of mesh increasing the volume. This creates a partial vacuum, drawing the liquid into the pump through the suction port (Fig. 1). The liquid fills the spaces between the teeth of the idler and the rotor and is carried past the crescent partition through the pressure side of the pump (Fig. 2). When the teeth mesh on the pressure side the liquid is forced from the spaces and out through the discharge port (Fig. 3).

Write today for catalogue 100. Or better yet, ask that a Tuthill Application Engineer call to discuss your specific pumping problem.

Tuthill manufactures a complete line of positive displacement rotary pumps in capacities from 1 to 200 GPM; for pressures to 1500 PSI; speeds to 3600 RPM.

PUMPS FOR YOUR PURPOSE

TUTHILL PUMP COMPANY

981 East 95th Street, Chicago 19, Illinois

Aeroquip's Extensive Product Lines

Fluid Piping

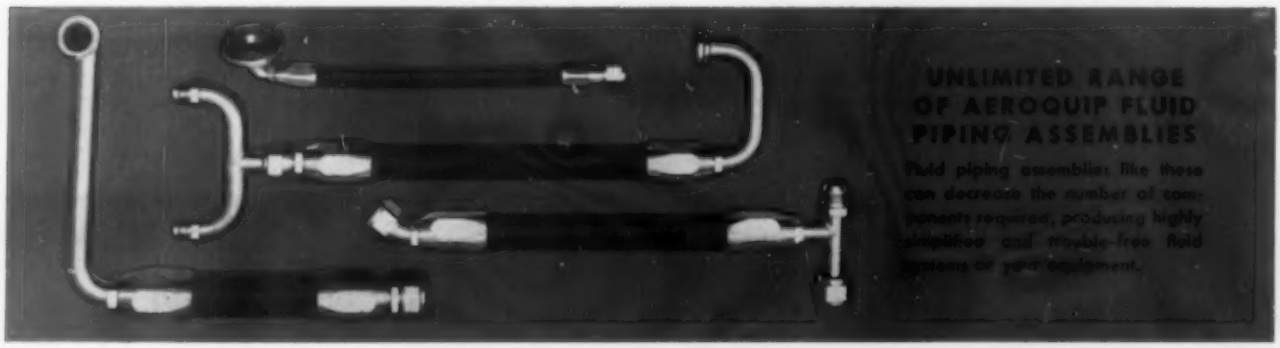
Highly qualified Aeroquip Sales Engineers are on call to furnish design assistance right in your engineering department. They follow through to assist at other stages of manufacture where Aeroquip's unmatched fluid line experience can also help you.

Aeroquip Field Engineers work with your engineers in building prototypes, assisting in fluid system test and modification.

Skilled Aeroquip Sales Engineers assist in various production planning functions, make time-saving and money-saving recommendations.

Aeroquip Service Engineers are trained troubleshooters who can analyze fluid systems under field conditions to verify system performance.

Experienced Aeroquip personnel work closely with your parts or service people to develop a service parts program to your exact requirements.



UNLIMITED RANGE OF AEROQUIP FLUID PIPING ASSEMBLIES

Fluid piping assemblies like these can decrease the number of components required, producing highly simplified and trouble-free fluid systems on your equipment.

And Facilities Provide Complete Service For Equipment Manufacturers

- DESIGN
- PROTOTYPE
- PRODUCTION
- FIELD SERVICE
- SERVICE PARTS

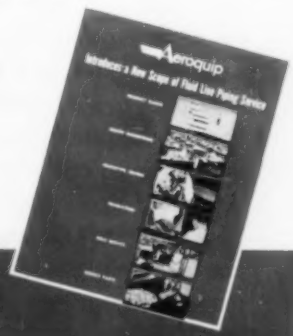
Aeroquip's unequaled experience in solving fluid piping problems has helped many equipment manufacturers save time and money. This experience is presented to you as the Aeroquip Fluid Piping Service. This unique service is available to any qualified equipment manufacturer desiring assistance in any and all phases of design, development or manufacture, as listed above.

Highly skilled Aeroquip sales and service engineers are available to work with you, in your plant or in the field.

Backed by the most complete line of fluid piping products and extensive engineering and manufacturing facilities, these specialists can help you solve any fluid line problem. In many cases, solving the problem results in simplification of a fluid system or fluid systems to a point where fewer component parts are required. This can cut material costs, reduce ordering, stocking and processing requirements.

If you would like more information on the Aeroquip Fluid Piping Service, please write to us.

Write Today for Your Copy of Bulletin 614 Describing the Benefits of the Aeroquip Fluid Piping Service.



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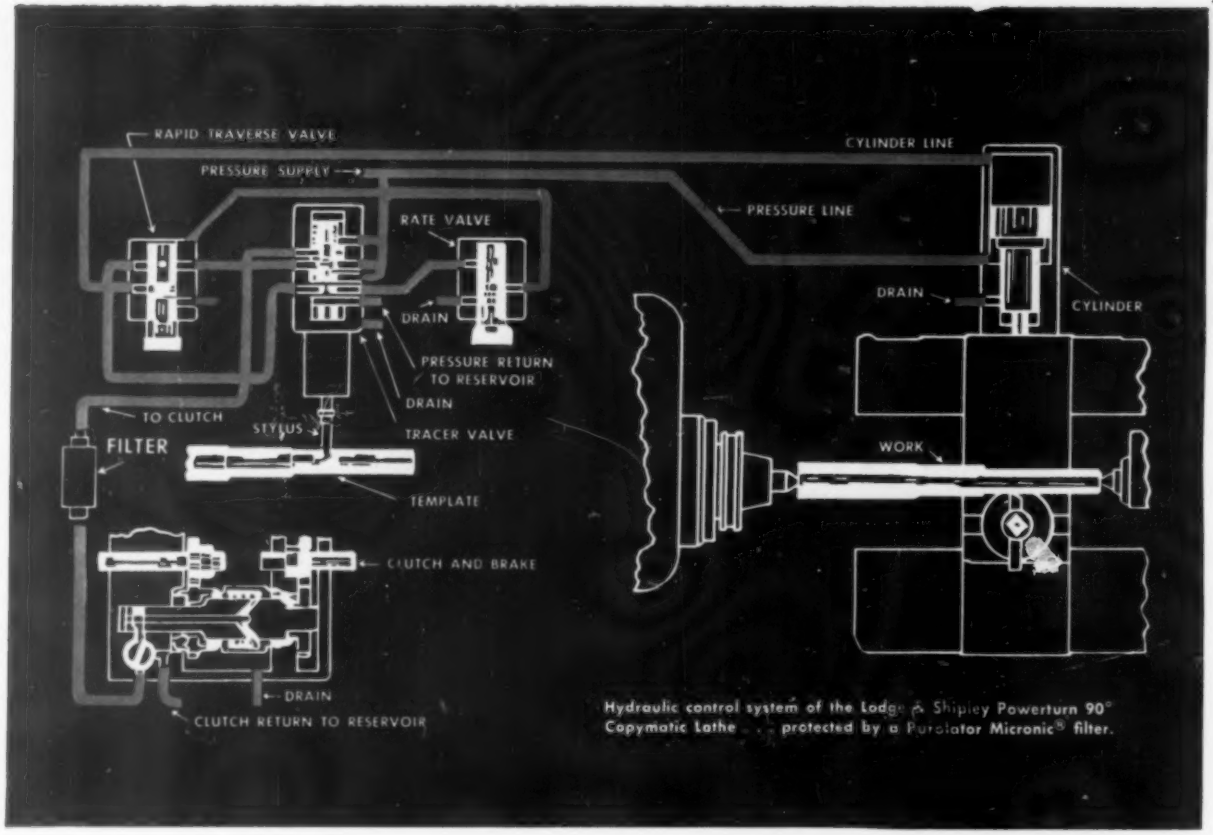

Designed for highly accurate control ...fully protected by Purolator Filtration

On a very successful automatic duplicating lathe, this hydraulic control system makes possible both quick, simple operation and a high degree of sensitivity and accuracy. Reliable and uninterrupted operation of a system like this is dependent upon freedom from contaminants. That's why the Lodge and Shipley Company, its manufacturer, made Purolator Micronic® filters an integral part of their hydraulic system.

Purolator engineers recommended a standard filter from their stock of over 2000 models. It more than met the system's special requirements.

The controlled porosity of Purolator's Micronic element evenly filters out contaminant particles as small as .000039 inch. And because it's made of plastic-impregnated cellulose, the Micronic element is not affected by high temperatures, water, or oil.

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PRODUCTS, INC.

"FIRST IN THE FIELD OF FILTERING"

Rahway, New Jersey and Toronto, Ontario, Canada

Filtering information for product designers is available in our 32 page "Filtration Manual for Product Designers". Just enclose 25¢ to cover postage and handling. Address Dept. P5-1126.

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INDUSTRIAL *Hydraulics*

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BERRY HYDRAULICS
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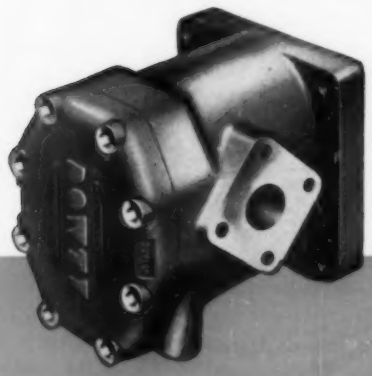

Gear Pump

Gear Motor

Precision built, cartridge construction, pressure balanced, in the ranges :—
Gear Pumps :- Flows at 1500 r.p.m. from ·50 to 50 Imp g.p.m.
Gear Motors :- Reversible. Outputs up to 25 H.P. Speed range 300-3000 r.p.m.

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BRIEFS

about fluid power

NCIH Takes a Look Ahead

CHICAGO—"Fluid Power in the 1960's" was the keynote set by Double A Products' John Pippenger for the 15th Annual National Conference on Industrial Hydraulics. Two full days (October 22nd and 23rd) of technical sessions were devoted to discussions of:

- Components and accessories
- Machine tools
- Pneumatics
- Pumps
- Materials forming machinery
- Mobile equipment
- Servomechanisms
- Space hydraulics
- Aircraft systems
- Hydraulic fluids

Following prepared papers which described new product developments and applications, question periods promoted interchange of design experience and a further understanding of common problems among designers.

Discussed matter-of-factly in many of the papers were design concepts which were "advanced", "sophisticated", and "exotic" only a few years ago. Servo valves and servo theory were discussed as freely as 4-ways valves and gear pumps. New filter materials, packing compounds, and flexible hose were analyzed to show how they'll solve tomorrow's problems. New applications like central systems for agricultural machines, hydrostatic traction drives, and variable-delivery pumps for tractor control were explained and discussed to point up specific installations and other possibilities.

Emphasizing the aircraft designer's constant search for reliability, J. C. Bloom of Douglas Aircraft said that sealing between metallic elements of hydraulic components is the biggest problem in getting a satisfactory hydraulic system. He described special seals designed by Douglas to replace O-rings in certain applications. These specials include a dual-step-seal Teflon piston ring for low friction, a D-ring to prevent spiral failure, and a V-groove pneumatic seal.

Filtration takes on major importance when your system includes precision components like servo valves. John Farris of Aircraft Porous Media covered the complete field of filtration for reliability in servo systems. Discussing servo valve design, he told how contaminants affect nozzles, flappers, spools, and wet motors. "A servo system should be assembled with pre-cleaned components that are absolute 3-micron pressure flushed immediately before installation," he said.

PRESENTATION OF PRIZE PAPER CONTEST AWARDS by Paul Rolnick, Editor and Publishing Director of APPLIED HYDRAULICS & PNEUMATICS, was part of the opening ceremonies. Shown here are winners Robert King, Frank Acton, Rolnick, August Lermer, Donald Grover, and Robert Danes.

• **Hydraulics' highway future**—How can we stop mounting highway accidents? One way is General Motors' Auto-Control system which has automatic guidance from a wire embedded in the road. Robert Van House described the electrohydraulic systems for steering and other functions in GM's *Firebird III* experimental car which can use this guidance.

"A central hydraulic system (see also page 67) offers greater flexibility, control, and economy when three or more circuits are involved." Expanding on this theme, Massey-Ferguson's A. H. Mark described development of a control system for a self-propelled combine.

• **Off-The-Shelf Servos**—Taking a step toward standard, build-

Continued on page 26

Circle 64 →

*After years....*if you do have to "repack"

JUST REPLACE 2 SELF-CONTAINED UNITS

IF IT'S A HUNT PDQ AIR VALVE

You want an air control valve that **one man can completely repack in a minute** on the bench or on the line.

We have that valve for you.

To repack the HUNT PDQ you just slide two simple self-contained units into place. One . . . the poppet spindle-sleeve assembly. Two . . . the plug-in solenoid pilot assembly. That's all!

You want a minimum inventory of spare parts. With the HUNT PDQ valve you stock **only two spare units** . . . not several dozen parts.

One man . . . any man . . . can completely repack the PDQ (including the solenoid pilot section) in less time than it takes you to read this ad. And your line is back in operation again.

This is the valve you want and need. Write today for the full story on the PDQ.

A. V. Ney, Sales Manager

HUNT VALVE COMPANY · SALEM, OHIO, U. S. A.

- ☑ Accessibility
- ☑ Simplicity
- ☐ Speed and Capacity
- ☐ Price and Quality

The Hunt PDQ valve tops them all in every class.

Next month . . .
the SPEED and CAPACITY story.

HUNT HVC ***Quick-As-Wink*** AIR & HYDRAULIC CONTROL VALVES

BECKETT Hi-CYCLIC

the valve name you need to know to fill any directional control application!

Beckett Hi-Cyclic Valves are sealed by **precision**, metal-to-metal fit. There are no working packings. Only the brass valve body and stainless steel spool are in contact with the media. These valves give **longest service life!**

Seven spool types meet all requirements. Special spools to specifications. Short spool stroke gives extremely **fast** reaction.

Practically every Beckett Hi-Cyclic Valve (more than 150 models) is a variation based upon a compact basic valve body. By adding suitable actuators, the basic valve is adapted to almost any given situation. Many actuator assemblies can be combined or interchanged, thus making the line of Hi-Cyclic Valves almost **universal** in range of application.

"SPECIALS" WELCOMED!

If a standard Hi-Cyclic Valve will not fulfill your needs, we welcome the opportunity to economically design and manufacture the valve to your most exacting specifications.

Write for complete valve catalog or detailed information on Hi-Cyclic Valves to meet your requirements.

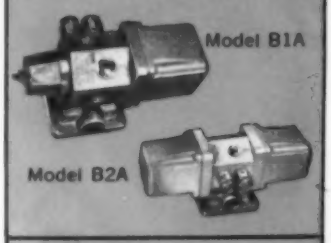
NFPA NATIONAL FLUID POWER ASSOCIATION MEMBER

DISTRIBUTORS IN MAJOR CITIES COAST-TO-COAST AND CANADA

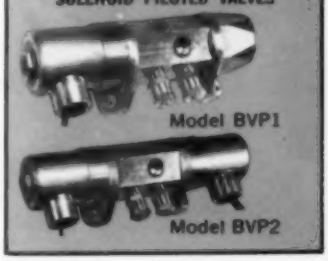
BECKETT-HARCUM COMPANY

981 W. Locust St., Wilmington, Ohio

DIRECT-ACTING SOLENOID VALVES

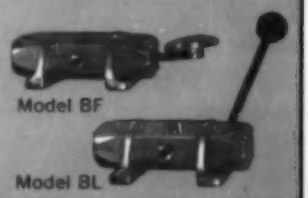


SOLENOID PILOTED VALVES

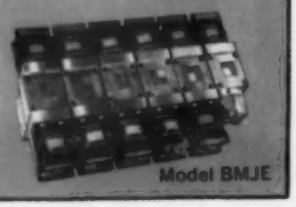


THE COMPLETE LINE OF PRECISION AIR AND HYDRAULIC CONTROL VALVES. N.P.T. SIZES 1/8" TO 1"

MANUAL, MECHANICAL AND PILOT ACTUATED VALVES



SINGLE SUBPLATE OR MANIFOLD MOUNTING VALVES (Including miniature valves that mount on 2" centers.)



Circle **25** on Time-Saver Card

BRIEFS

ing block components for machine tool servo systems, C. B. Sung and J. R. Farron of Bendix Aviation defined design criteria for industrial hydraulic servo components. Most engineering which depends on an extensive knowledge of control theory is required to compensate for components designed for other applications, they said. Better-designed components will permit simpler application to a variety of machines.

A basic source of industrial power since the days when overhead belts made a factory look like a forest, pneumatics is still finding new applications such as handling equipment and assembly

CONFERENCE DIRECTOR ROBERT SHARPE, of Socony Mobil Oil Company opened the conference with an introduction of John Pippenger, Double A Products Div., Brown and Sharpe Mfg. Corp. (seated at right)

machines. Some of the new components which give air its versatility were listed by General Motors' Ward Diehl as: small, low cost shuttle valves, non-repeat and single cycle devices, miniature air cylinders for signalling, and air timing valves.

• **Servo Valve or Servo Pump?**—Variable volume pumps can compete with servo valve control on higher power machines like Hufford's new spin forge. Robert Fillmore of Minneapolis-Honeywell, showed the wide potential of these pumps for automatic control. They have excellent load response and high power gain. At power levels where ef-

Continued on page 28

DYNAMIC DIFFERENCE

in hydraulic performance

Webster

POSITIVE DISPLACEMENT GEAR-TYPE PUMPS

Things have changed on the golf course . . . the old converted Model A has been replaced by more efficient, specialty equipment. Like this Worthington mowing rig. It has front wheel drive, rear wheel steering and gang mowers that raise and lower hydraulically.

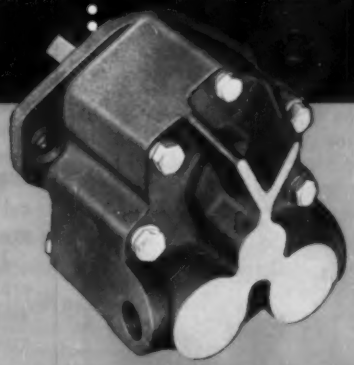
A fast-acting Webster hydraulic pump supplies a dependable flow of fluid power for this versatile application. For this same reason, Websters are used on all types of construction, maintenance, agricultural and industrial equipment. More, Webster Gear-Type Pumps are compact — adapt easily and economically to the job and your product.

Hydraulics in your design? Keep Webster in mind *for the dynamic difference that pays!*

OIL HYDRAULICS DIVISION

WEBSTER ELECTRIC

our 50th year **RracINE · WIS**



HCS SERIES POSITIVE DISPLACEMENT GEAR-TYPE PUMP

Shaft seal: lip type
Drive: direct, gear or belt
Capacity: 5 sizes, 5 - 17 gpm
Pressure: to 1500 psi
Operating speeds: to 2400 rpm (1800 rpm max. on 4XC5)
Porting: side (Std.) end (Opt.)
Valve: optional; internal relief, adjustable 800 - 1500 psi

BULLETIN HY1 gives complete engineering characteristics — performance and installation data.

Call the man from Webster

. . . he's one of a staff of engineers specially trained in hydraulic application. He can help you solve special problems when hydraulics become a part of your design.

Photo from Worthington Mower Company, Stroudsburg, Pa., a subsidiary of Jacobsen Manufacturing Co., Racine, Wis.

THE TUBE FINALLY
BURST
BUT IN EXCESS OF
20,000 P.S.I.*

AND THE
Rubbernek
FLARELESS
FITTING
STILL HELD TIGHT!

Hydrostatic tests prove Rubbernek's sealing properties are maintained at pressures in excess of 20,000 p.s.i. Vibration and pulsating pressure abuse showed no detrimental effect. Time after time, Rubbernek withstood test conditions far more severe than those encountered in actual service.

*Test reports available upon request

Rubbernek
absorbs shock, vibration. Assures positive seal. Foolproof installation saves time. Can be reconnected repeatedly. Meets J.I.C. standards.

Test it yourself on the most critical application.

YOUR INQUIRY INVITED

CHICAGO FORGING
& MANUFACTURING CO.
2004-A SOUTHPORT AVENUE
CHICAGO 14, ILLINOIS

Circle 31 on Time-Saver Card

BRIEFS

ficiency is important, the fast response may be better than required, considering inertias of machine masses.

What's the best slide positioner for a tape controlled machine? Three systems were analyzed by P. J. Herzl of Sperry Gyroscope of Canada in his description of a turret drill press. Cylinders have the advantage of completely eliminating all backlash, but their length affects system stiffness. Most common drive is a lead screw driven by a fluid motor or electric motor. This is generally more expensive than cylinders, but may have a higher stiffness. Lead screws may also have more backlash. Rack-and-pinion drives are used on very large machines, and are the stiffest designs. The only deflections are in the gear teeth and oil compression. Backlash is quite severe. ▼▼▼

NFPA Maps Program for Growth

DETROIT: "The National Fluid Power Association can be a great stimulant for our industry's growth". This was NFPA president Lynn Charlson's keynote idea at the fall meeting.

• **Organization changes**—Members received charts showing three new proposals for organization. Each suggests establishing operating divisions to be headed by a vice president and to provide its own marketing and technical functions. Each proposal differs in the definition of the divisions. The first suggests four divisions by product: rotary devices, control devices, linear devices, and supplementary devices.

Proposal two shows geographical divisions: western, mid-western, and eastern.

Five markets: agricultural, aircraft, industrial hydraulic, marine, and pneumatic are suggested divisions in proposal three. These plans will be discussed at the spring meeting.

• **Fluid power market**—NFPA was influential in establishing a Fluid Power Advisory Group in the Business and Defense Services Administration of the U. S. Department of Commerce.

BDSA has made progress on its first survey of the industry. After surveying 580 companies, the established list of possible producers is now 303. Dollar figures have been supplied by 290 manufacturers. The companies make: pumps, valves, cylinders, accumulators, and compressors.

Estimated dollar values	
Shipments in 1957	
Domestic	$491,000,000
Export	24,000,000
By system type	
Hydraulic	$370,000,000
Pneumatic	145,000,000

• **Management services**—A written "Recommended Ethical

Continued on page 30

ESTABLISHING SALES TERRITORIES was Borge Rosaen's subject. At left is program director Bill Richards, executive v-p, Bellows. Marketing board chairman, Bob Firth is at right.

Circle 82 →

Save 27% or more in cost...

NEW

Miller

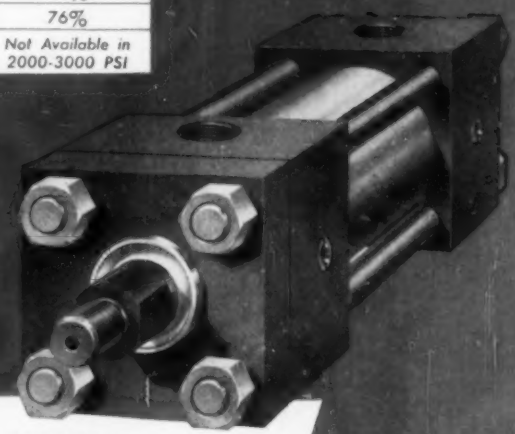
"JOB RATED"

HYDRAULIC CYLINDER LINE

JOB RATED, MODEL " J "

BORE	SEVERE OPERATING CONDITIONS	MODERATE OPERATING CONDITIONS	YOU SAVE THIS % IN PRICE OVER STANDARD 2000-3000 PSI CYLINDERS
1½"	1500 PSI	2500 PSI	27%
2	1500	2500	27%
2½	1000	1500	28%
3¼	1500	2500	32%
4	1000	1500	35%
5	800	1200	37%
6	800	1200	43%
8	500	800	50%
10	500	800	71%
12	500	800	76%
14	500	800	*Not Available in 2000-3000 PSI*

with ***IDENTICAL*** *seals, design, and safety factors as the famous Miller "Power-Packed" Model "H" Line for 3000-5000 psi service.*



SEAL FAILURE MEANS CYLINDER FAILURE!

1. *No seal made of synthetic rubber is compatible with even 50% of available, commercial, petroleum base hydraulic fluids.*

MILLER Uses All Teflon* Seals to Eliminate External Oil Leakage because Teflon is impervious to all known hydraulic fluids, even fire-resistant types.

TEFLON SHEF SEAL At Tubing Ends

No blind assembly. Is
Shear-proof
Heat-proof
Extrusion-proof
Fluid-proof

TEFLON Seals On Piston Rod And Bushing

Teflon rod flange seal requires no adjustment. Teflon bushing seal is shearproof. Teflon wiper keeps dirt out.

TEFLON Seals On Ball Check And Adjusting Screw

Non-protruding, self-locking, cushion adjusting screw interchangeable with ball check for easy access.

MILLER Uses Resin-Impregnated Leather Piston Cup Seals because they are compatible with petroleum base fluids and some fire-resistant types. Teflon cups available at small extra cost.

2. *Nicked or scored piston rods cause seal failure*

MILLER Uses Case-Hardened Chrome-Plated Piston Rods because they prevent nicks, scoring and rust.

NOW! . . . You can save MORE with quality Miller "Job-Rated" Cylinders than with cut-price, lesser quality hydraulic cylinders. And the "Job-Rated" Cylinders are also available under the same immediate shipment program as the Power-Packed Line (2 hours if necessary—3 days normal).

* Fast trademark for totally repellent resin which withstands temperatures from —100° F. to +400° F. and all hydraulic fluids.

OTHER MILLER QUALITY FEATURES

- Rust-Resistant Surfaces
- Interchangeable, Space-Saving Square, 4-Tie-Rod Design
- Precision Honed Barrels

MILLER FLUID POWER

DIVISION OF TEXTRON INC.

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SEE ALSO HYDRAULIC CYLINDERS • ACCUMULATORS • COUNTERBALANCE CYLINDERS • BOOSTERS

HERE'S A HELPFUL AND CONVENIENT REFERENCE SOURCE

for ***COMPARATIVE SPECIFICATIONS***
CHEMICAL ANALYSES
MINIMUM PHYSICAL PROPERTIES

...clearly charted in SHENANGO'S new Bulletin No. 157

This invaluable chart of nonferrous alloys centrifugally cast by Shenango is readily available upon request. For your free copy, write to this publication or the Centrifugally Cast Products Division, The Shenango Furnace Company, Dover, Ohio.

SHENANGO CENTRIFUGAL CASTINGS

COPPER, TIN, LEAD, ZINC BRONZES · ALUMINUM AND MANGANESE BRONZES
MONEL METAL · NI-RESIST · MEEHANITE METAL · ALLOY IRONS · DUCTILE IRON

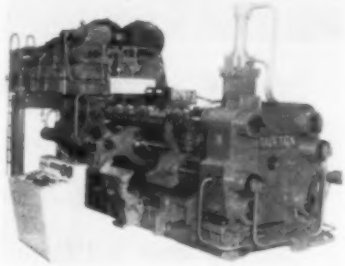
Circle **106** on Time-Saver Card

BRIEFS

Principles" is one important achievement of NFPA's membership. David Fromson NFPA's counsel presented the draft which is the result of about 4 years study.

The education committee has completed a survey of colleges (see AH&P, October 1959 page 26). Means of assisting colleges with educational tools are now being studied.

Hugh Federer, Teer-Wickwire's president, discussed the value of management ratios as a yardstick for financial self-appraisal. Describing the availability of such statistical information in other industries, Federer recommended that members of NFPA supply information from which ratios



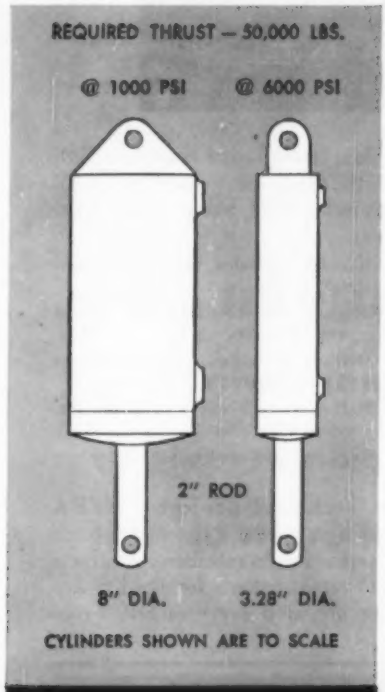
HORIZONTAL HYDRAULIC EXTRUSION PRESS has a 1500-ton capacity. Made by Sutton Engineering Co., Pittsburgh, it can be used on ferrous and nonferrous metals. One installation for nuclear materials required a completely shielded working area for operation in an inert atmosphere.

such as: current assets to current debt, net profits to net sales, net sales to inventory, etc. could be compiled.

• **Marketing**—Barrett Rogers, NFPA's secretary, reported that most member companies are now supplying monthly sales figures. These are being tabulated by products and the summary sent to all participating companies.

Borge Rosaen, general sales manager, Double A Products, described his company's methods of evaluating and assigning sales territories.

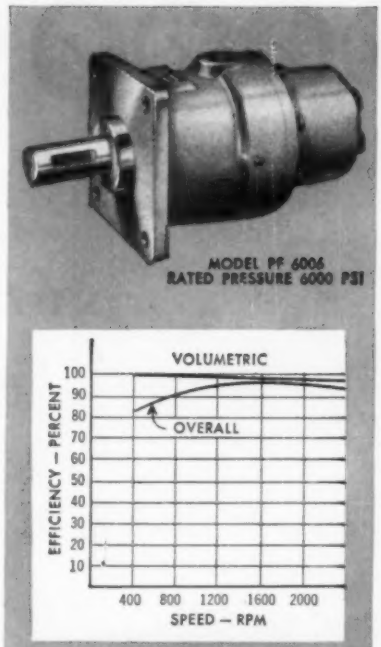
Continued on page 32



HIGH PRESSURE IS

COMPACTNESS

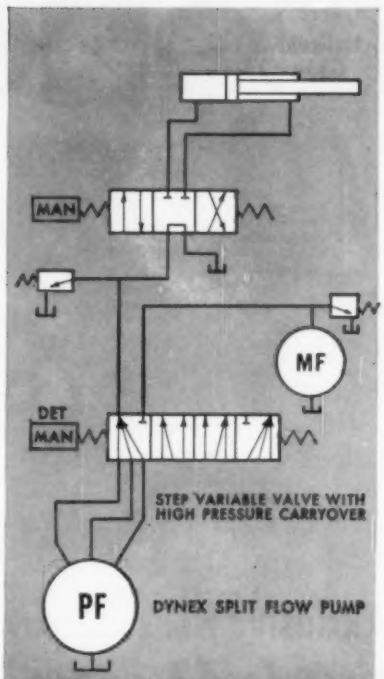
Component size reduction provides the greatest gain in going to higher pressure systems. For example, a 3¼" diameter cylinder will do the work of an 8" diameter cylinder if the relative pressures are 6000 PSI and 1000 PSI (shown above). Since less oil has to be transmitted to do a given job, the line sizes are dramatically reduced, as is the oil reservoir, valving, etc. Since size and weight are usually directly proportional, the comments applied to size, in general, hold for weight. Very sizeable reductions in the weight of cylinders are encountered since they are so much smaller.



HIGH PRESSURE IS

EFFICIENCY

A high pressure system uses piston pumps with an overall efficiency of 90% to 96%. Comparable gear pumps and vane pumps in low pressure systems have efficiencies of 70% to 85%, ordinarily. Since less flow is being transmitted through a high pressure circuit, less power loss due to pressure drop is encountered. All circuit loss manifests itself as heat — thus, it is not uncommon for a high pressure circuit to remain operating under heavy duty cycle where a low pressure system would overheat. This is particularly true in transmissions.



HIGH PRESSURE IS

FLEXIBILITY

Piston pumps in which the flow can be split into two or more separate circuits can allow a single pump to replace two or more pumps and operate each circuit at different pressure levels. New slide valves in which the tank port can withstand full pressure opens up new circuit possibilities. A valving sequence is established whereby the upstream valve has priority, but when the flow is not required at that point, it is available at a remote downstream point at full working pressure. This splitting and combining of flow at will can generate novel and unique circuits.

dynex INC.
A DEVELOPMENT OF BLACKHAWK MFG. CO.
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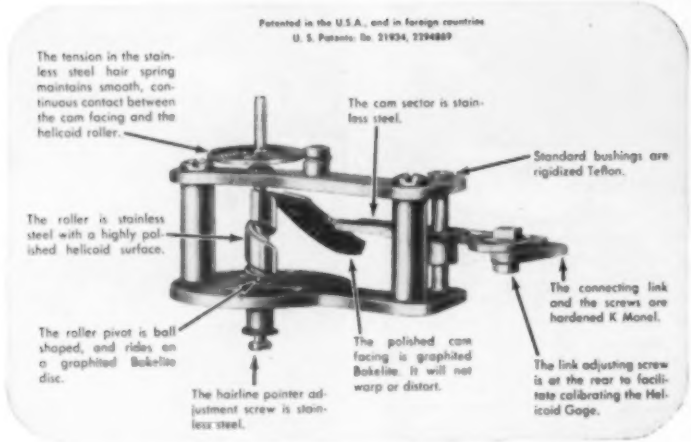
Circle **43** on Time-Saver Card

ACCO Helicoid Gage U.S.A.

Patented in the U.S.A., and in foreign countries
U. S. Patents: Re. 21934, 2294889


The tension in the stainless steel hair spring maintains smooth, continuous contact between the cam facing and the helicoid roller.
The cam sector is stainless steel.
Standard bushings are rigidized Teflon.
The roller is stainless steel with a highly polished helicoid surface.
The connecting link and the screws are hardened K Monel.
The roller pivot is ball shaped, and rides on a graphited Bakelite disc.
The polished cam facing is graphited Bakelite. It will not warp or distort.
The link adjusting screw is at the rear to facilitate calibrating the Helicoid Gage.
The hairline pointer adjustment screw is stainless steel.

Exclusive Helicoid movement provides... *Sustained Accuracy... on the toughest jobs*

• Helicoid Gages have no gears, no teeth, reducing wear to an absolute minimum. No danger of fouling, either—rolling action of cam facing keeps contact surface clean. Helicoid Gages have been tested through 75,000,000 cycles, with virtually no wear or loss of accuracy, while conventional geared gages became useless after 500,000 cycles.

Helicoid Gages give *sustained* accuracy even when subjected to violent pressure pulsations or mechanical vibrations. Pointer can be set externally, without removing glass, and cannot be jarred out of position. Dial faces are easy to read, won't corrode or chip. A full range of Helicoid Gages is available for any application. Next time, specify Helicoid—the gage that *stays* accurate.

Bourdon Tubes won't Stretch, Leak, or Crack

Helicoid Bourdon tubes are made from seamless tubing, and are designed for maximum torque and minimum stress. At the factory, each tube is individually tested, overpressured, and stress relieved. Four materials—alloy steel, K Monel, stainless steel, and phosphor bronze—are available to meet applications ranging from tap water to almost any acid.

NEW! Solid-Front Safety Case Gives Added Protection

The new Helicoid solid-front case diverts the force of a burst in a backward direction, away from the operator. The force escapes by deforming, though not detaching, the back cover plate. Helicoid Gages are also available in phenol, acaloy flanged, acaloy flangeless, polished flangeless, round flush, polished flush ring, and square flush cases.

Distributed in Canada by
Upton, Bradeen & James, Ltd.
Quebec, Montreal, Ottawa, Toronto, Hamilton, Windsor, Winnipeg, Edmonton, Vancouver

WRITE for details

Ask for Catalog DH-65

HELICOID GAGES

Helicoid Gage Division • American Chain & Cable Company, Inc.
929-H Connecticut Ave., Bridgeport 2, Conn.

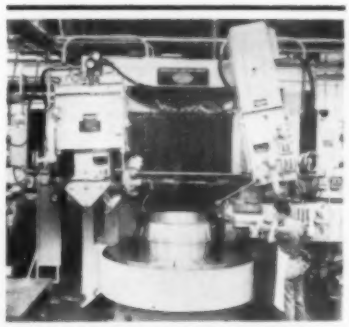
Circle **61** on Time-Saver Card

BRIEFS

Marketing board chairman, Bob Firth, presented a schedule of 12 projects. Five being worked on are:

- Manufacturer-sales agency co-assistance study
- Geographical distribution of fluid power markets
- Methods of evaluation and assignment of sales territories
- Marketing problems created by foreign competition
- Sales statistic survey and service

• **Technical projects**—NFPA has now started a Patent Research Service for its members. Abstracts of current patents for fluid power are prepared every month. From Patent Gazettes issued in September, 77 patents were abstracted.



VERTICAL CHUCKING GRINDER has hydraulic slides for accurate positioning. The machine weighs over 100 tons and can grind bearings with an outside diameter of 7 feet. It is accurate within 0.0002 inch. Made by the Bullard Co., for Timken Roller Bearing Co., in Canton, Ohio.

Workshops discussed gathering information on various fluid power components. Projects concern standardization on nomenclature, recommendations for Joint Industry Conference Standards, dimensions, ratings and maintenance.

Manufacturers of cylinders have now agreed on preferred bore sizes (see AH&P July 1959 page 28). They will soon release standard dimensioning nomenclature.

Next NFPA meeting will be at the Grand Hotel, Point Clear, Alabama, May, 9-11. NEPA headquarters are at 5595 N. Hollywood Ave., Milwaukee 17, Wis. ▼▼▼

Continued on page 36

Circle **91** ➔

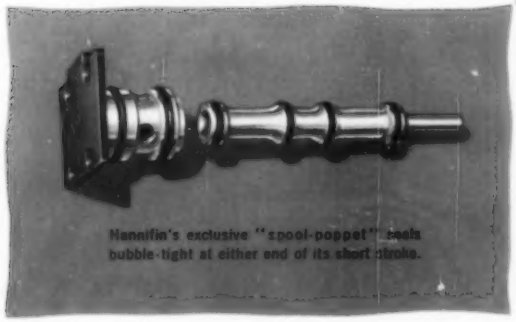
From HANNIFIN...

unit construction

to give you air valves

that do more jobs

Hannifin ⅜" four-way valve with "universal" base and new Speed Control section. Single-solenoid actuated, 10 other actuators available.



Hannifin's exclusive "spool-poppet" seals bubble-tight at either end of its short stroke.

For complete E. I. C. compliance, valve is electrically inoperative until dust-tight, splashproof solenoid cover is replaced and fastened tightly. Result: no more clogged, jammed solenoids.

One of the versatile—and most popular—Hannifin air control valves is this "CC" series, single-solenoid model. It is available for either ¼" or ⅜" air lines and is gasket-mounted to its own base. This particular base (one of three choices offered) can either be O-ring gasketed to your manifold or mounted over an opening in your bracket or machine. It will receive all four lines from below or take the inlet line from below and the two cylinder lines out one side. Or, you can make all connections at the sides.

When it comes to actuation, Hannifin offers an even wider selection: hand, foot, cam, pressure, single or double solenoid.

When necessary, you can remove this entire valve from its base without disconnecting air lines. Or, the exclusive "spool-poppet" can be replaced without even breaking electrical connections.

The "CC" series, like all Hannifin valves, is designed with "full flow" internal passages as large or larger than its rated pipe size.

You will find these and most other Hannifin valves described in Hannifin's new "Valve Finder." Get your copy from your Hannifin man, listed in the A-Z volume of Thomas' Register, or write:

HANNIFIN COMPANY
525 South Wolf Road • Des Plaines, Illinois

IPC
molds the tough ones . . . leather or synthetic!

The "Custom" approach, already made famous by IPC oil seals and packings is *also* reflected when IPC tackles unusual molded shapes. If you require an unusual molding from rubber or synthetic material, *or* if you need a seal of special shape and specific properties, IPC *can* help you. By using the "custom" approach IPC will actually develop a tailored product to suit your application.

Wide experience in compounding synthetic materials gives IPC a distinct edge in developing special seals or molded shapes. IPC leather products incorporate top grade materials and elaborate laboratory control.

When you feel you have a tough nut to crack, call on IPC . . . We'll be happy to show you unusual *custom molding* samples, at your request.

OIL SEALS
PACKINGS
PRECISION MOLDING
Custom designed . . . for your application

IPC

INTERNATIONAL PACKINGS CORPORATION

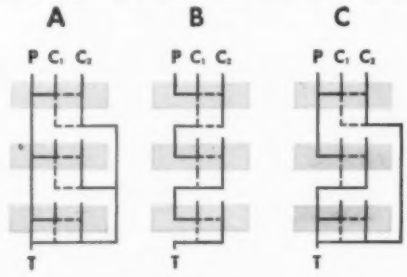
Bristol, New Hampshire

P3

NEW MOBILE VALVE

From Brown & Sharpe/Double A—

An Electrically Controlled Mobile Valve



VALVE CIRCUIT VARIATIONS

The Double A mobile valve is for service up to 2000 psi, and has a nominal rating of 15 gpm. Many valve circuit variations are possible. The two basic ones are: A. Series supply with parallel exhaust. B. Supply and exhaust in one continuous series. Many variations between the two are possible, as shown in diagram C.

Designed for modern mobile equipment applications, this Double A mobile hydraulic valve leapfrogs present day components to answer all the foreseeable needs of equipment builders—electrically controlled pilot operators—built-in flow controls over input and individual spools—plug-in type electrical hook-ups—economical multiple-spindle housings having three spools (shown above) or two spools (coming soon)—wide choice of valve circuits.

This valve, the first of its kind, is installed in the most efficient, economical place rather than where operator convenience dictates. It is remote controlled by 12-volt DC* oil immersed, dirt-proof solenoids (with palm button manual override) which operate matched pilot valve spools. Priced for mobile equipment sales.

An adjustable, pressure compensated flow control valve is built in to provide constant flows under varying loads and engine speeds (optional). For even finer flow control, individual flow controls are available at any of the three 4-way spools (as shown above).

Mobile equipment requirements are met in the Cannon plug-in wiring connectors (solenoids are all pre-wired to the connector), the straight-thread (or NTP) ports for mobile hose fittings, and the provisions for mounting the valve.

**also 6, 18, 24, 36, 50, etc.*

Brown & Sharpe

HYDRAULICS DIVISION

GEAR, VANE & CENTRIFUGAL PUMPS
DOUBLE A VALVES
GEROTOR PUMPS
POWER UNITS

B·S

PROGRESS IN PRECISION FOR OVER 125 YEARS

GET COMPLETE INFORMATION
on Double A hydraulic mobile valves.
ASK FOR VT-03-DDD sheets.

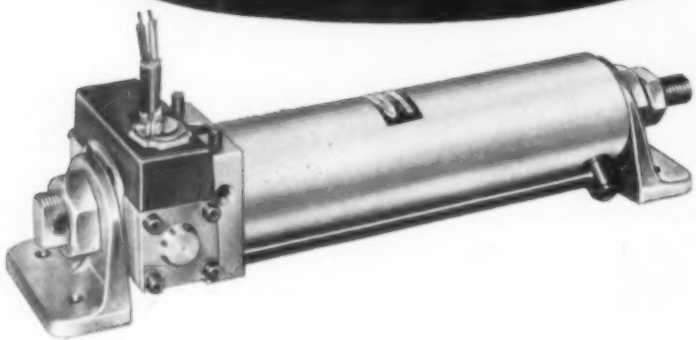
Take advantage of Double A hydraulic developments. Contact your nearest Double A hydraulic distributor. Or write to **Double A Products Co.**, a subsidiary of Brown & Sharpe Mfg. Co., Manchester, Michigan.

Now-SAVE SPACE, WEIGHT & PIPING

with **NEW**

Modernair
Trademark

VIH (VALVE-IN-HEAD) CYLINDERS



Here's a combination that's hard to beat — a performance-proved industrial air cylinder with its own built-in directional and exhaust speed control valves — in a single, compact "package". Check these important features:

- **BUILT-IN DIRECTIONAL CONTROL VALVES...** your choice of four control combination; double solenoid, single solenoid with button bleeder return, double button bleeder, or double remote pilot pressure operation.
- **BUILT-IN EXHAUST SPEED CONTROLS** with automatic Nylon lock.
- **INTERCHANGEABLE MOUNTINGS...** front or rear flange, low or high "L" foot brackets, rod and cylinder clevis.
- **SINGLE CONDUIT CONNECTION** for double solenoid unit.
- **AVAILABLE WITH CUSHIONED STOP** either or both ends.
- **PERFORMANCE-PROVED MODERNAIR CONSTRUCTION**

Condensed Specifications

DIAMETERS: 1½", 2", 3"
ROD SIZES: ½", ⅝", ¾"
MIN. OPERATING PRESSURE: 20 p.s.i.
SOLENOID POWER REQUIRED: 10 watts
MAX. OPERATING PRESSURE: 150 p.s.i. (solenoid) 200 p.s.i. (bleeder or pilot pressure)
SOLENOID COILS AVAILABLE: (ac) 8-10, 110, 220 v. (dc) 12, 24, 30 v.

Call your local MODERNAIR sales outlet (see Modernair trademark under "CYLINDERS" in the yellow section of your phone book) or write us today for complete data bulletin; please address Dept. B-12.

Modernair CORPORATION 37
400 Preda Street · San Leandro, California
MEMBER NATIONAL FLUID POWER ASSOCIATION

Circle **84** on Time-Saver Card

BRIEFS

Hydraulic System Protects Canal Locks

A 15-ton chain stretches across the locks in case the famed "Panama Canal Mules" lose their towline to the ship. If the mules can't

Courtesy De Laval Steam Turbine Co.

stop the ship after it moves into a lock, the ship runs into the chain and is snubbed to a stop. The chains are connected to a hydraulic system which keeps a constant tension of 100 tons on them.

Two, 2-stage, centrifugal pumps with impellers back-to-back neutralized the hydraulic thrust. ▼▼▼

Single Hydraulic System Does Double Duty

A single hydraulic system powers both a heavy-duty, front-end loader and a power digger on a tractor by Sherman Products, Inc., Royal Oak, Mich.

Operation of both parts, which share a common sub-frame, is simultaneous.

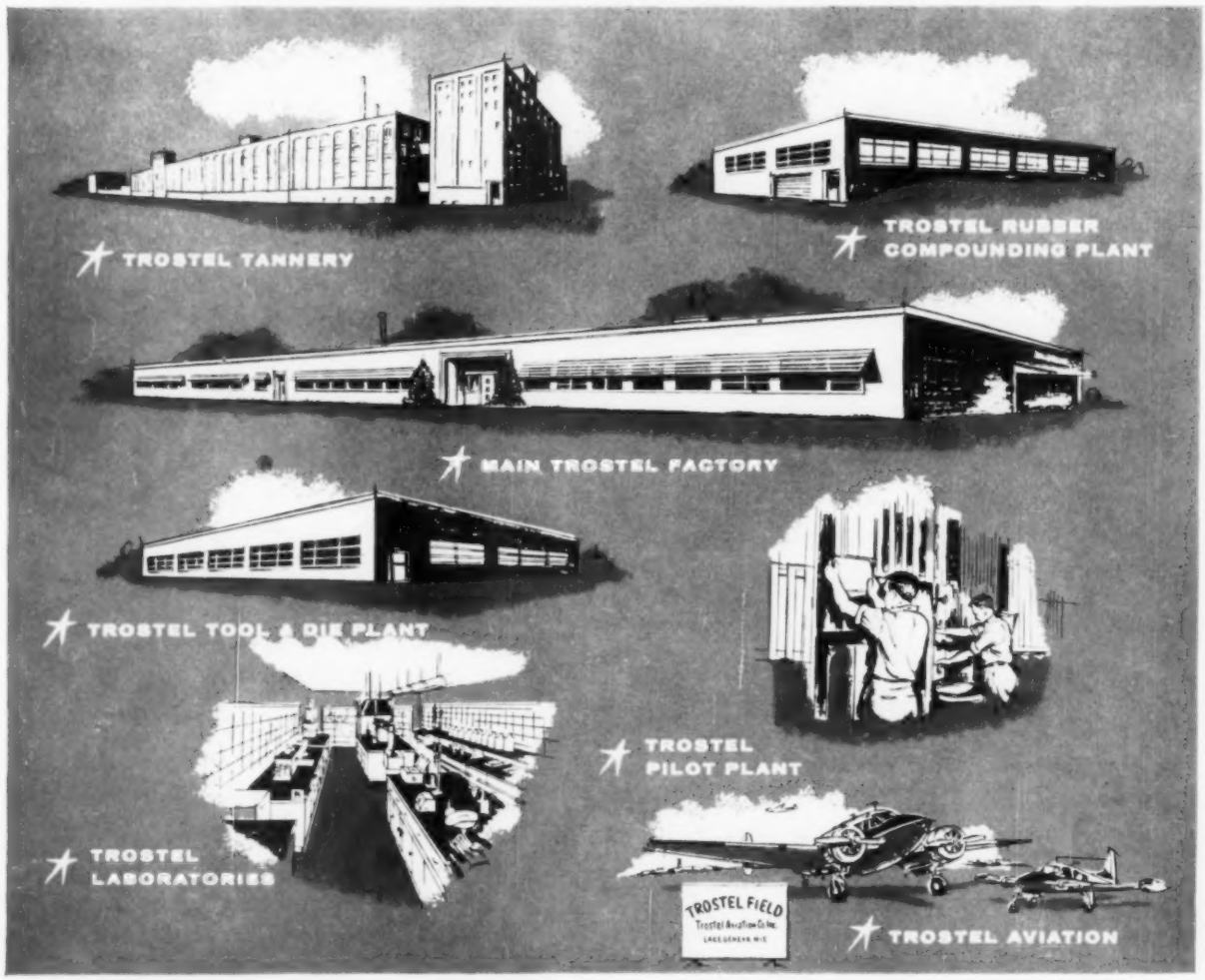
The Hydra-Loop system has a full flow filter on top of the fender tank with a built-in relief valve

Continued on page 38

TROSTEL

A complete producing organization for

☆OIL SEALS ☆PACKINGS ☆O-RINGS



Quality in every phase of supply and manufacture is assured through Trostel ownership of all essential facilities

From raw materials to finished product, all key sources of supply and manufacture are Trostel owned and operated. Leather is tanned at the Trostel Tannery. Rubber is compounded at the Trostel Compounding Plant. Dies are made at the Trostel Tool and Die Works. Three separate Trostel Laboratories conduct research in leather, impregnations, and synthetics. A pilot plant tests all production runs. When, therefore, parts and materials arrive at the point of manufacture into seals and packings they are uniformly standard in specifications. Manufacture itself is by automatic machinery in a modern plant, with a quality control system that insures close-tolerance accuracy in all operations. Special delivery and service are provided by Trostel Aviation . . . we can come to you quickly, or bring you to us.

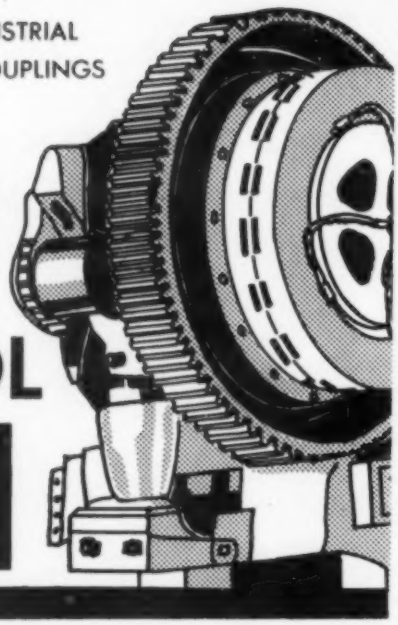
Trostel control of its products from raw materials to delivery is your guarantee of dependably high quality at all times, on every order. For catalog and technical data, write Albert Trostel Packings, Ltd., 700 Madison St., Lake Geneva, Wis.

TROSTEL
QUALITY
SINCE 1858

PACKINGS
OIL-SEALS
O-RINGS

Roylyn INDUSTRIAL COUPLINGS

KEEP the wheels of industry COOL



ALL PURPOSE *Industrial "Quick"* **COUPLINGS**

The mighty machines of American industry "keep cool" with lines connected quickly and easily with Roylyn Industrial Couplings. Too, the fluids that nourish these machines pass through these popular couplings from tank to tank car to truck to user.

IMPORTANT FEATURES

Quick Connecting
Full Flow
Ease of Operation
Positive Lock
Rugged Construction
Open and Self-Sealing
High Pressure Seal
Longer Life
Increased Efficiency
Economical
Vibration Proof
Minimum Maintenance
Maximum Efficiency
Adaptability between Like Sizes
Sizes from ¼" to 3"

Open

Self-Sealing

INDUSTRIAL APPLICATIONS

Hydraulic Test Stands
Pulp and Paper Mills
Soap Industry
Sugar Refineries
Public Utilities
Rolling Mills
Annealing Plants
Petroleum
Petro-chemical
Canneries

. . . and many other applications requiring fast, safe and sure "quick" couplings.

The Best Connections in the World

DESIGNED • MARKETED BY AIRATERRA

620 PAULA AVENUE • GLENDALE 1, CALIFORNIA

Circle 5 on Time-Saver Card

BRIEFS

and dirty filter indicator. Breakaway power of the loader, at bucket lip, is 5000 lb., with a full lift capacity of 2500 lb.

By using special tools, the digger can be easily detached from the tractor, freeing the machine for other uses.

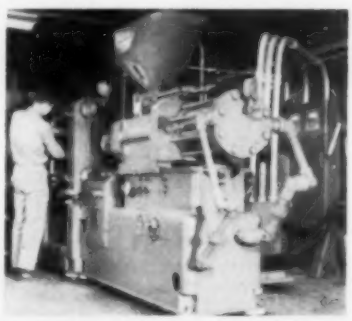
Digging and loading stresses throughout the tractor are equalized by the full-length box frame and channel construction subframe assembly which also provides additional rigidity.

The loader has cross channel supports to absorb torsion loading.

Cylinders use internal oil porting through cylinder trunnion and rod to minimize external plumbing. Steel tubing is used for hydraulic lines to give greater strength, easier service and assembly, decrease resistance to oil flow, and reduce the chance of leakage. ▼▼▼

Swivel Joints Stand High Shock Pressures

Every time the ram moves forward on an injection molding machine, the hydraulic system pressure rises from 0 to over 2000 psi. These pressure surges cause repeated shock on the supply lines. The lines must be flexible, because the entire feeding end of the machine must move back and forth on tracks.



Reed-Prentice Co. uses rigid pipe supply lines with swivel joint connectors for flexibility. Since

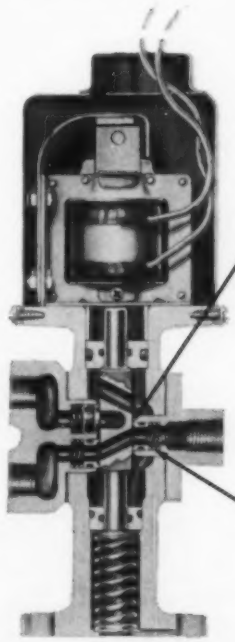
Continued on page 40

DO YOU SHARE THESE COMMON MISBELIEFS ABOUT SOLENOID AIR VALVES?

"THE SOLENOID IS TO BLAME FOR COIL BURNOUT"
Very seldom. In most cases, and particularly with spool valves, sticking valve members create overloads, overheating and coil burnout.

"AIR IS FREE"
Perhaps a little ridiculous, but the way many plants waste it, you would think it was free. Actually, compressed air not properly controlled can be the most costly power medium you use. We have a study on the dollar cost of air leaks that will blow your hat off.

"AIR VALVES ARE ALL ABOUT THE SAME"
When they are new they all work fine. While all other valves start going down-hill with every operation, the sealing qualities of Barksdale Valves are improved through operation.



SHEAR-SEAL VALVE DESIGN PROTECTS THE MOST EXPENSIVE COMPONENT, THE SOLENOID, AGAINST OVERLOADS.

WEAR COMPENSATING FEATURE CONSERVES COSTLY AIR

There is a Barksdale representative in your vicinity who has the facts supporting the above statements.

Send for the bulletin:
"Benefits offered by
Barksdale AIR-SEAL Valves."

CONTROL VALVE DIVISION
Barksdale valves

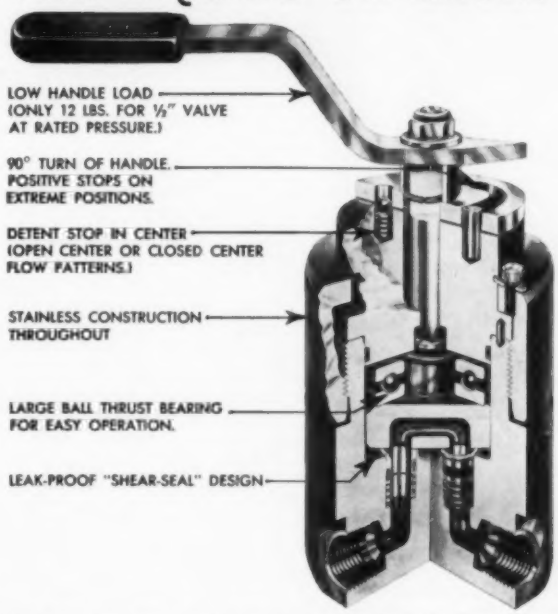
5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

Circle **23** on Time-Saver Card

10,000 P.S.I.

4 WAY VALVE

FOR LIQUIDS OR GASES


LOW HANDLE LOAD (ONLY 12 LBS. FOR ⅛" VALVE AT RATED PRESSURE.)
90° TURN OF HANDLE. POSITIVE STOPS ON EXTREME POSITIONS.
DETENT STOP IN CENTER (OPEN CENTER OR CLOSED CENTER FLOW PATTERNS.)
STAINLESS CONSTRUCTION THROUGHOUT
LARGE BALL THRUST BEARING FOR EASY OPERATION.
LEAK-PROOF "SHEAR-SEAL" DESIGN

This new four-way valve series comes in pipe sizes from ¼ to 1 inch, but may be obtained with tube, AND 10050, or any preferred special high pressure connection. It will withstand surges of up to 15,000 P.S.I. without damage to the valve's sealing qualities. It is designed for a burst pressure of 30,000 P.S.I.

No port to port leakage occurs in the detented positions because of the exclusive "Shear-Seal" design.

Long, maintenance-free service is assured because the optically flat metal to metal sealing surfaces of the sealing rings and mating rotor faces are protected by staying in constant intimate contact; flow is always through the center of the "Shear-Seal", never across sealing surfaces (as in conventional valve design). Sealing qualities actually improve as the self aligning "Shear-Seals" lap themselves to a more perfect fit with each valve operation.

Of course, there is no external shaft leakage, because the pressure is confined to the flow passages.

This highly successful principle of extreme pressure control is fully described in "Shear-Seal" bulletin BVM-2.

CONTROL VALVE DIVISION
Barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

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by
LINEAR

in Kel-F, Viton-A, Vyram, Polyurethane, and other unusual elastomeric materials having excellent resistance to many petroleum oils, synthetic lubricants, fuels, phosphate and silicate ester fluids—in a temperature range of —40° to +500° F.

LINEAR—specialists in close-tolerance molding in all of today's modern polymers . . . in both fabric reinforced and homogeneous materials.

These are automatic seals. For further help, call the LINEAR engineer.

PERFECTION IN RUBBER
LINEAR
LINEAR, Inc. STATE ROAD & LEVICK ST. PHILA 35 PA

Circle **75** on Time-Saver Card

BRIEFS

the alignment of the moving portion of the machine is constant, single plane swivels are used.

The all-metal construction eliminates danger from bursting hose. The only maintenance required on the joints is occasional repacking. ▼▼▼

AIEE Conference on Machine Tools

Higher accuracy and finer speed control received primary consideration at the American Institute of Electrical Engineers 11th annual machine tool conference in Cleveland.

One of the papers, presented by George M. Coon of Textrol Inc., covered a pneumatic-electric interlock for a mechanical press. The circuit uses air valves with extended stems to monitor the valve's position by actuating limit switches. (A complete description of this circuit appeared in the August 1959 issue of APPLIED HYDRAULICS & PNEUMATICS.)

Other papers covered various methods of regulating drive speed, and recent advancements in switch and control equipment. ▼▼▼

BRIEF NOTES

TWO COURSES IN HYDRAULICS . . . are offered by the Milwaukee School of Engineering's Evening Division. The courses cover fluid mechanics, hydraulic components, circuitry, and trouble-shooting. Emphasis is given mobile equipment hydraulics, including newer, high-pressure systems. The school's Industrial Advisory Committee for Hydraulics, organized over a year ago, developed the program.

NUCLEAR REACTOR CONTROL ROD DRIVES . . . A bulletin by the General Electric Apparatus Sales Div., Schenectady, describes a fluid power control rod drive for water-cooled nuclear reactors. The rod is driven by a water-operated piston which uses the reactor's coolant water. In a mechanical drive system, fluid power is used for load balance and scram control.

CAPACITY COEFFICIENTS FOR AIR CONTROL VALVES . . . have been compiled from laboratory measurements of air flow rates through production valves. Hannifin Co.'s latest Valve Finder revision indexes air flow capacities for the valve port sizes. Also included are an engineering formula for use with the data, and sections on valve terms and principles.

EX-CELL-O LICENSES KEELAVITE . . . Keelavite Hydraulics Ltd., Allesley, England, will manufacture and market the Rotac rotary actuator under license from Ex-Cell-O Corp., Greenville, Ohio. Keelavite will make both standard and heavy duty models with single or double vanes.

BUSINESS BRIEFS

PARKER NETS $768,889 . . . Parker-Hannifin Corp. earned a net profit of $768,889 on sales of $12,753,136 for the quarter ending September 30, 1959. This compares with a $526,935 profit on sales of $9,118,241 for the third quarter of 1958. The earnings break down to 59c per share on 1,302,820 shares, compared with 41c per share on 1,294,202 shares in the 1958 period.

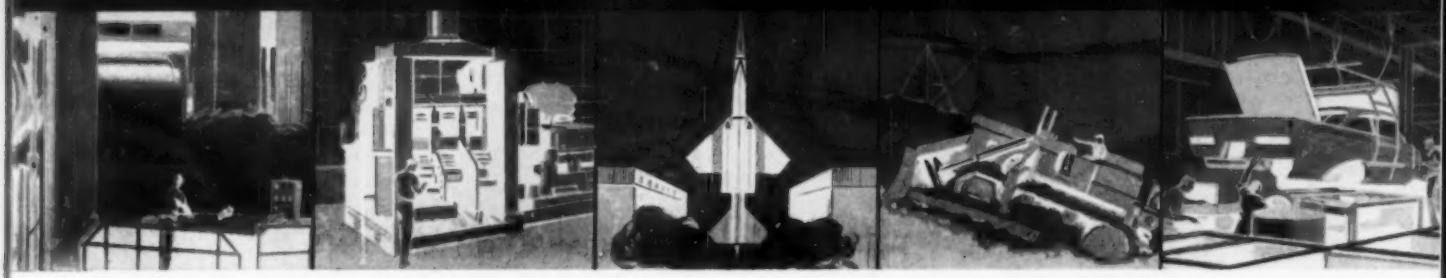
JAMESBURY EXPANDS AGAIN . . . Jamesbury Corp., Worcester, Mass., has begun an addition to its ball valve manufacturing plant. Floor space will be 70% greater. A recent expansion increased space fivefold. Demands from industry and the U. S. Navy necessitated the building. Twenty-one nuclear submarines use the valves.

COOPER-BESSEMER BUYS ROTOR TOOL . . . The Rotor Tool Co., Cleveland is now a wholly-owned subsidiary of The Cooper-Bessemer Corp., Mount Vernon, Ohio. Rotor shareholders have received 98,998 shares of Cooper-Bessemer stock. The subsidiary's management and facilities are as before. Rotor president Herbert P. Bailey is now on the C-B board, and president E. L. Miller and other C-B executives are on the Rotor Tool board.

Circle 15 →

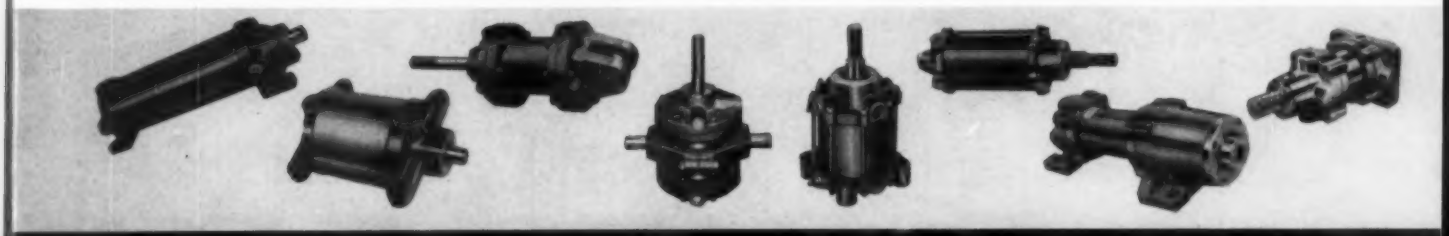
Experience proved in every major industry . . . ANKER-HOLTH

POWER CYLINDERS SAVE YOU TIME, TROUBLE AND MONEY

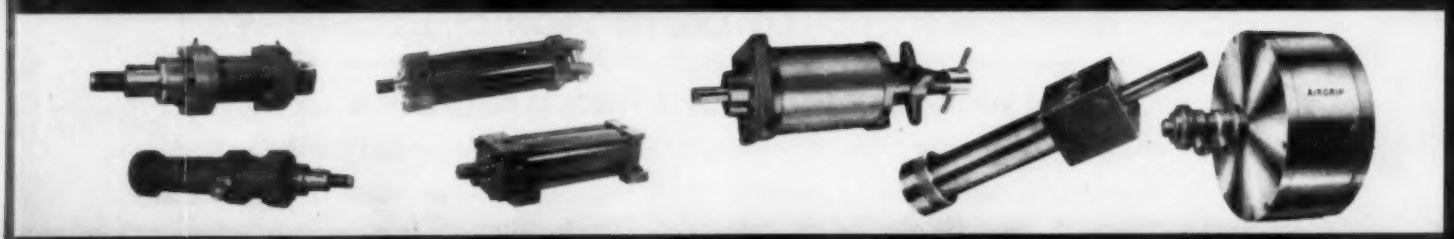


Select your needs

from the World's Widest Selection of Standard Cylinders



Check these compelling reasons why Anker-Holth air and hydraulic power cylinders save you time, trouble and money – widest selection of standard models ∨ reliability through military accepted quality control program ∨ simplified maintenance ∨ all mountings available ∨ bores 1" to 30" ∨ strokes to 40' ∨ built to JIC specifications ∨ nationwide engineering service on call ∨ complete facilities to engineer any power cylinder application outside the standard model.



Only a few models could be shown above

This free catalog shows them all

ANKER HOLTH

DIVISION, THE McDOWELL-WELLMAN COMPANIES

Send this B-1

ANKER-HOLTH DIVISION
THE WELLMAN ENGINEERING COMPANY
2723 CONNOR STREET, PORT HURON, MICH., U. S. A.

Name_____

Company_____

Address_____

How B&W JOB-MATCHED LECTROSONIC* J.I.C. TUBES solve hydraulic fluid line problems

New J.I.C. Standards approve welded carbon steel tubing for hydraulic fluid lines—and B&W makes such tubing—

Five quality control checks—including 100% ultrasonic inspection — help assure you maximum dependability from B&W Job-Matched Lectrosonic J.I.C. Hydraulic Fluid Line Tubing. You get:

- . . . a full range of sizes and dimensional exactness and uniformity — matched to your job in every detail
- . . . controlled mechanical properties — to give ease of fabrication and save you installation time
- . . . long, trouble-free service life — even in the most exacting applications

B&W will be glad to help you select exactly the right tube for efficient, economical service. Call your local B&W District Sales Specialist, or write for Bulletin 435 for full information. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

*Welded Carbon Steel Tubing

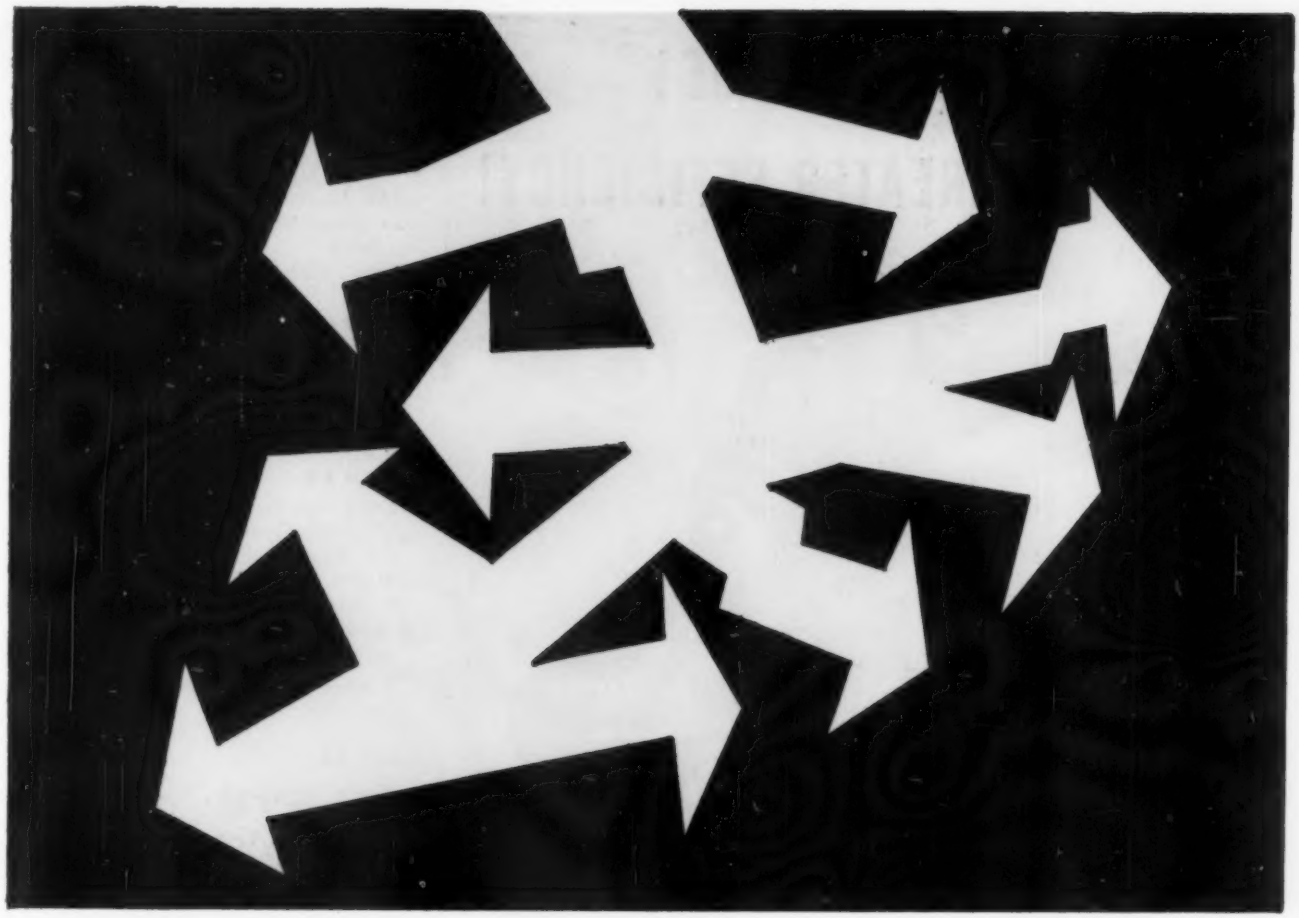
B&W

THE BABCOCK & WILCOX COMPANY

TUBULAR PRODUCTS DIVISION

TA-9039-WM3

Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals



DIRECTIONAL CONTROL absolute control

of movement in any direction can

only be achieved by hydraulic power.

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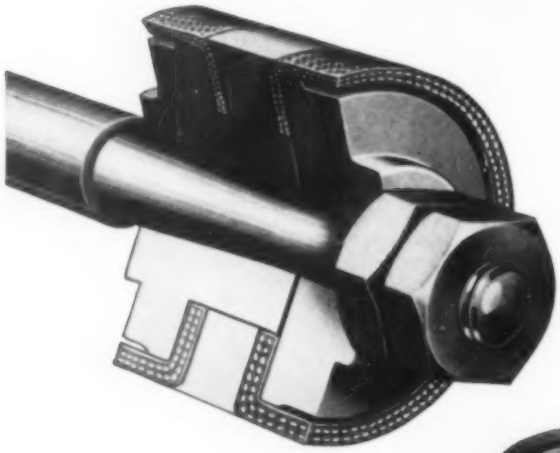
LESS DOWNTIME!
GREATER EFFICIENCY!



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...in hydraulic and pneumatic mechanisms, reciprocating pumps

Darcova 45° Bevel Type Pumcup

THE BIG DIFFERENCE you'll find in Darcova Pumcups is that they operate at full efficiency *throughout their entire life.* This means fluid slippage is virtually eliminated.

And because fewer replacements are necessary, you have less downtime. Users report that Pumcups *outlast ordinary packings at least 3 to 1!*

Pumcups are available in three textures—hard, medium and soft. Also in regular or 100% nylon composition. Sizes range from ¾" to 20". For all the facts on Pumcups, write for Bulletin 5903.

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Williamsport 15, Pa.

DARCOVA
THE ORIGINAL COMPOSITION CUP
TRADE MARK
PUMCUPS

Circle **36** on Time-Saver Card

FUTURE EVENTS

JANUARY 11-15
SAE Annual Meeting
Sheraton-Cadillac & Statler Hilton Hotels
Detroit, Mich.

JANUARY 25-28
Plant Maintenance & Engineering Show
Convention Hall
Philadelphia, Pa.

MARCH 6-9
ASME Gas Turbine Power & Hydraulic Conference
Rice Hotel
Houston, Texas

MARCH 14-15
ASME Lubrication Symposium
Engineering Societies Building
New York, N. Y.

APRIL 4-8
Nuclear Congress & Exhibit
Coliseum
New York, N. Y.

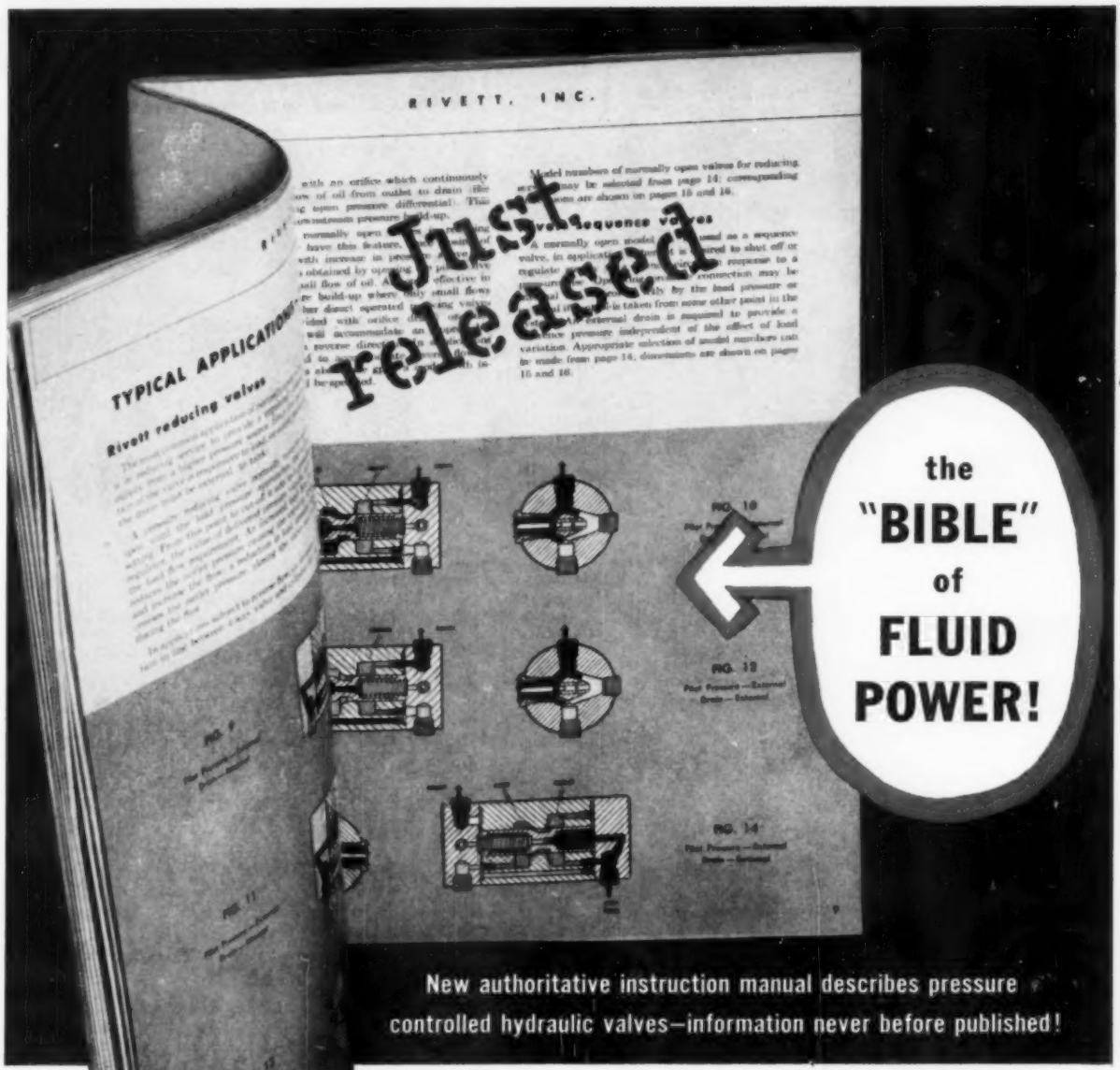
APRIL 6-8
National Meeting
The Institute of Environmental Sciences
Biltmore Hotel
Los Angeles, Calif.

APRIL 18-19
3rd Annual Conference on Automated Techniques
Sponsored by ASME, IRE, and AIEE
Cleveland-Sheraton Hotel
Cleveland, Ohio

APRIL 21-28
ASTE Tool Show & Annual Convention
Detroit, Mich.

MAY 9-11
National Fluid Power Association Spring Meeting
Grand Hotel
Point Clear, Alabama

MAY 9-13
2nd Southwestern Metal Exposition & Congress
State Fair Park, Automobile Building
Dallas, Texas


RIVETT, INC.
TYPICAL APPLICATIONS
Rivett reducing valves
Just released
the "BIBLE" of FLUID POWER!
New authoritative instruction manual describes pressure controlled hydraulic valves—information never before published!

You will find this complete and factual material extremely valuable for planning a modern hydraulic circuit! Written by engineers long experienced in fluid power design, this new 8½ x 11 book shows operations and applications of all pressure controlled valves — relief, sequence, reducing, unloading and counterbalance.

A helpful guide to selecting the proper valve for the job, Rivett's new Catalog No. 230 discusses in detail all factors influencing correct choice: normal spool position, operating pressure source, pilot or direct operation. Also shown are flow diagrams, pressure vs. flow curves, ratings, dimensions, drawings and specifications.

For your free copy of Catalog No. 230, write on company letterhead to

RIVETT, INCORPORATED, DEPT. AH-12
Brighton 35, Boston, Massachusetts

RIVETT furnishes a complete power package

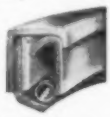
AIR AND HYDRAULIC — VALVES, CYLINDERS, POWER UNITS

Member—National Fluid Power Association

NATIONAL OIL SEAL LOGBOOK

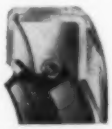
Oil Seal Selector Chart

The data given below indicate, for most common applications, the type of oil seal that will operate best under given conditions. Where one or more parameters are extreme, modified or special seals may be required. For engineering help or availability details, call the nearest National Seal Engineer. Look under Oil Seals, in the Yellow Pages.



50,000 series
Micro-Torc
Leather

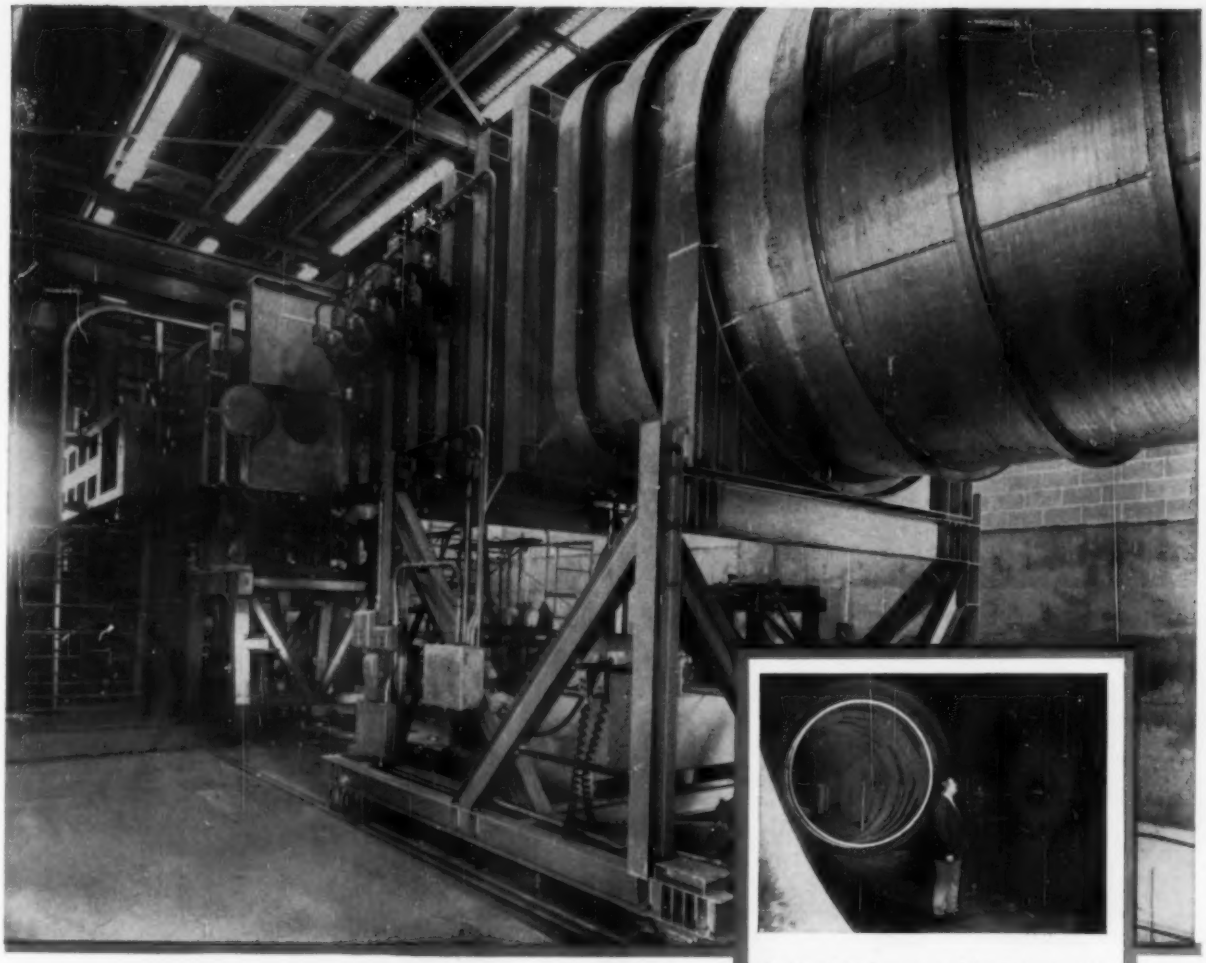
450,000 series
Syntech
Synthetic



410,000 series
Syntech
Synthetic

MATERIAL SEALED	Mineral base oils and greases are most common materials. Availability of lubricant, criticalness of service, and cleanliness strongly influence construction choice. National Micro-Torc leather seals are recommended for grease and oil applications and particularly where semi-starved lubricant conditions may exist. For oil and fluid "zero leakage" service Syntech seals are normally considered. For applications involving both "zero leakage" and heavy dirt conditions, the user may wish to consider dual lip Syntech seals.			
SHAFT SPEED	Prime factor in seal selection. Governs all other factors. Shown in FEET PER MINUTE AS SLOW, MODERATE, HIGH.			
FPM	Slow	0 to 800	0 to 1000	0 to 1000
	Moderate	800 to 1500	1000 to 2000	1000 to 2000
	High	1500 to 2000	2000 to 3000	2000 to 3000
TEMPERATURE	Limits shown are points where sealing material or medium sealed becomes ineffective. For sealing under extreme temperature conditions, special compounds can be employed.			
LIMITS °F.	Continuous	−65° +200°	−65° +225°	−65° +225°
	Intermittent	−65° +225°	−60° +250°	−60° +250°
PRESSURE	Conventional oil seals are not pressure seals. Where pressures above those shown exist, special seals should be employed or pressure against sealing lip relieved.			
MAXIMUM PSI	Slow	15	10	10
	Moderate	10	7	7
	High	5	5	5
SHAFT FINISH	Fineness and type of finish, direction and spiral of finishing marks and leads as well as RMS value affect sealing. Polished or ground finishes with concentric finish marks are preferred.			
MAXIMUM MICRO INCHES	Slow	25	25	25
	Moderate	20	20	20
	High	20	20	20
SHAFT HARDNESS	Although shafts as soft as cold rolled steel can be sealed successfully, hardness of C20 Rockwell or greater is preferred. Fluid starvation, abrasives and high surface speeds require hard shafts.			
SUGGESTED ROCKWELL	Abrasives	above C-45	above C-45	above C-45
	No abrasives	above B-80	above B-80	above B-80
SHAFT TO BORE MISALIGNMENT	Fixed misalignment of center of shaft rotation with bore center. Concentrates wear at one side of seal. Becomes more severe as speed increases.			
TOTAL INDICATOR	Slow	.010	.015	.015
	Moderate	.005	.010	.010
	High	.005	.010	.010
SHAFT RUN-OUT	Oscillating non-concentricity between shaft and bore centers (also eccentricity or shaft whip). Run-out should be kept to absolute minimum; creates difficult sealing problem.			
TOTAL INDICATOR R P M	0-800	.010	.025	.025
	800-2200	.005	.020	.020
	2200-4200	.003	.015	.015

NATIONAL SEAL
Division, Federal-Mogul-Bower Bearings, Inc.
General Offices: Redwood City, California
Plants: Redwood City and Downey, California
Van Wert, Ohio



Scale models of space age airframe components will be tested here in McDonnell Aircraft's new supersonic wind tunnel at St. Louis. Tunnel will simulate the flight conditions tomorrow's aircraft will encounter.

LIFEBLOOD OF THIS NEW SUPERSONIC WIND TUNNEL...

HOUGHTO-SAFE hydraulic fluids!

Here was a real problem—to actuate hydraulic mechanisms in a man-made wind tunnel simulating the fastest, the hottest, the highest air flights of ten years ahead—

Up to 4,000 miles per hour . . .
From minus 65° to plus 660°F . . .
Up to 125,000 feet in the air

Oil would not be safe at those pressures and temperatures—but Houghto-Safe fire-resistant hydraulic fluids are! That's why they have been installed, thus making sprinklers—a hazard to costly electronic equipment—unnecessary.

Probably wind tunnels are not your problem. But if hydraulic equipment is, it will pay you to check on Houghto-Safe. Call the nearest Houghton office, or write E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

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HYDRAULIC FLUIDS

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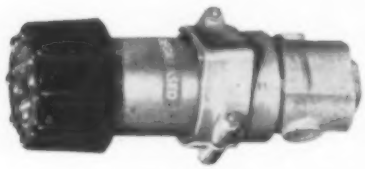
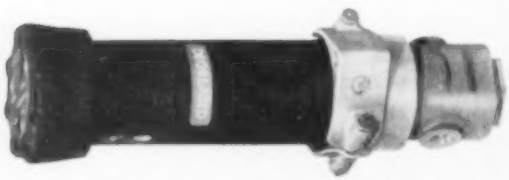
Wherever high-pressure pneumatics are used, the APCO series of high- and ultra-high pressure regulators provides the ultimate versatility for instrumentation and service systems applications. APCO Servo Loaders accept the highest inlet pressures – provide the widest range of *precise* outlet pressures . . . are easily adjusted through a low-torque planetary gear handle or a 28 V DC actuator. Available with either ¼-inch tube or ¼-inch NPT threaded ports – valve and filter may be removed for inspection, cleaning, or replacement without disconnecting the regulator from its system! . . . Write today for technical data.

. . . the most versatile high-pressure regulators available



110400
- Extreme accuracy in control
- Inlet pressure – 6000 psi
- Regulated outlet pressure in specified ranges

113300
- All stainless steel construction in flow area – cleaned for LOX
- Inlet pressure 6000 psi
- Regulated outlet pressure – as specified



110700
- Maximum handle torque 35 lb-inch
- Regulated inlet pressure 6000 psi
- Regulated outlet pressure – 150 to 5000 psi

117300
- Maximum handle torque 50 lb-inch
- Inlet pressure 10,000 psi
- Regulated outlet pressure – 100 to 8000 psi

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The Complete Line of

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reusable hydraulic hose and couplings

The quality line for original equipment . . . the preferred line for fast, easy on-the-job replacements! Let Surgepruf be your one dependable source of hose, couplings and components for every industrial and automotive application! High-pressure, medium-high pressure and low-pressure hose for temperature operating range of −40° to +275°F. Couplings are reusable. Complete range of hose sizes and couplings, as well as adapters and swivel adapters. One of Alemite's 34 strategically located distributors is ready to give you prompt, complete service!

Medium-High and High-Pressure Hydraulic Hose and Fittings. Single and double wire braid hose. Non-skive feature assures easy assemblies in seconds. Seamless inner tube of Buna-N rubber and Neoprene outer cover. Resists abrasion, weather and oil. High strength reusable couplings. No special tools required.

New Low-Pressure "Shur-Lock" Hose—for use on fuel, filter, oil, air and vacuum gauge lines. Rugged, precision-matched couplings. Leak-proof grip. General purpose hose and coupling utility kit eliminates need for large inventory.

Replacement or Display Kit No. 2208

Permits fast, easy on-the-spot assemblies for most common low-pressure automotive applications.

Replacement or Display Kit No. 2209

For low pressure fleet, automotive and industrial general purpose use.

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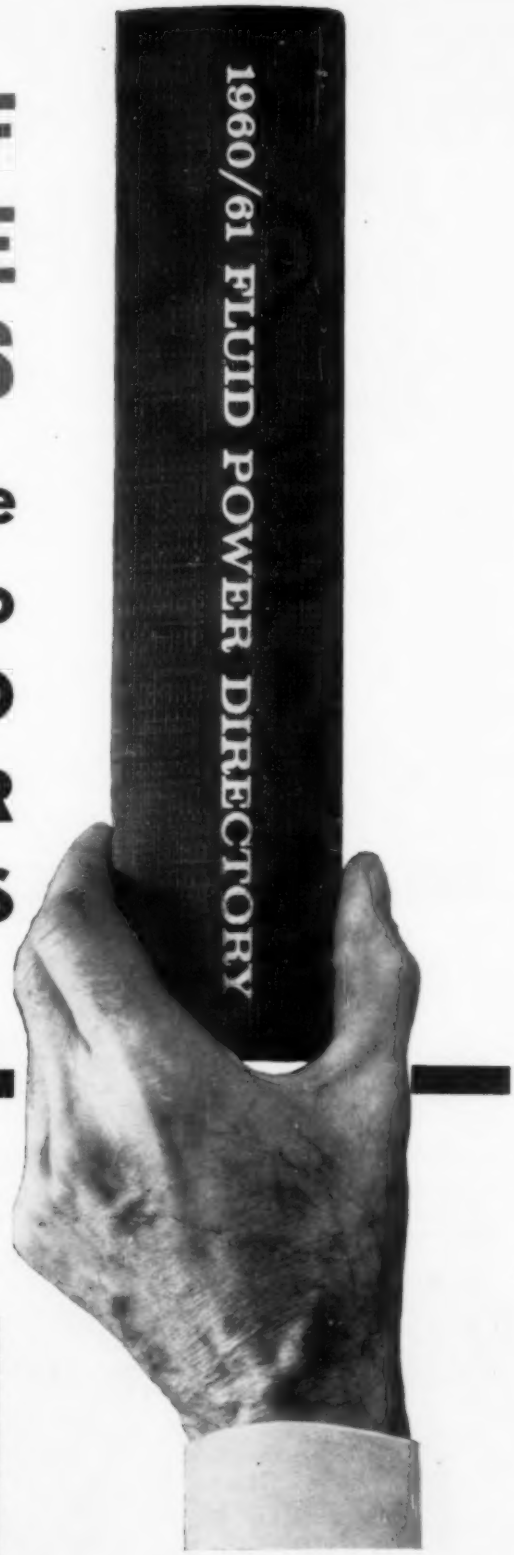

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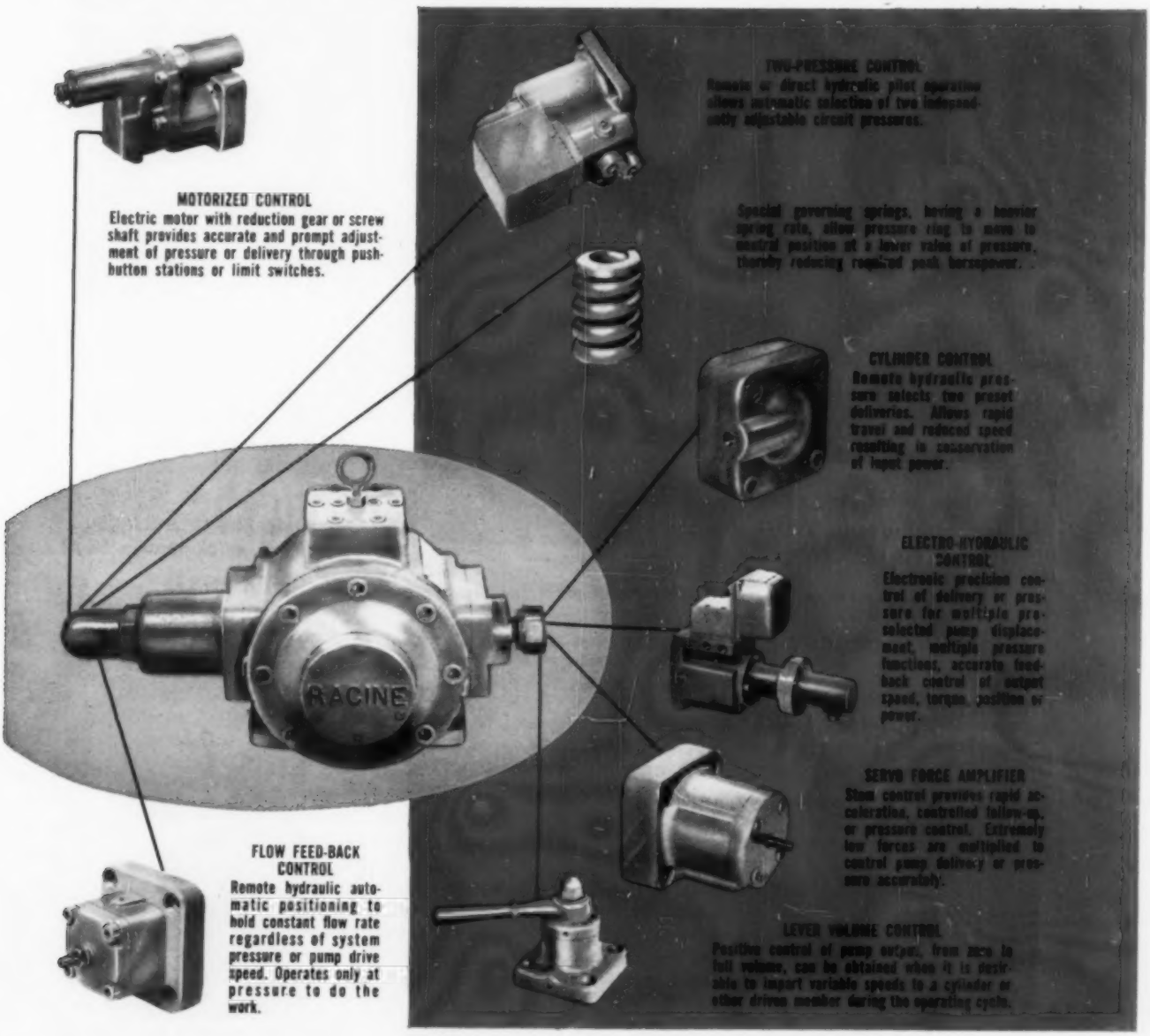
The Magazine of Fluid Power

RACINE-SECO®

Variable Volume Vane Type **PUMP CONTROLS . . .**


MOTORIZED CONTROL
Electric motor with reduction gear or screw shaft provides accurate and prompt adjustment of pressure or delivery through push-button stations or limit switches.
TWO-PRESSURE CONTROL
Remote or direct hydraulic pilot operation allows automatic selection of two independently adjustable circuit pressures.
Special governing springs, having a heavier spring rate, allow pressure ring to move to neutral position at a lower value of pressure, thereby reducing required peak horsepower.
CYLINDER CONTROL
Remote hydraulic pressure selects two preset deliveries. Allows rapid travel and reduced speed resulting in conservation of input power.
ELECTRO-HYDRAULIC CONTROL
Electronic precision control of delivery or pressure for multiple pre-selected pump displacement, multiple pressure functions, accurate feedback control of output speed, torque, position or power.
SERVO FORCE AMPLIFIER
Stem control provides rapid acceleration, controlled follow-up, or pressure control. Extremely low forces are multiplied to control pump delivery or pressure accurately.
LEVER VOLUME CONTROL
Positive control of pump output, from zero to full volume, can be obtained when it is desirable to impart variable speeds to a cylinder or other driven member during the operating cycle.
FLOW FEED-BACK CONTROL
Remote hydraulic automatic positioning to hold constant flow rate regardless of system pressure or pump drive speed. Operates only at pressure to do the work.
RACINE

Write for Catalog No. 59-A describing RACINE-SECO complete line of Hydraulic Equipment.

RACINE SECO

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RACINE, WISCONSIN

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NEW PRODUCTS

Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.

HYDRAULIC CYLINDERS . . . have unique cushioning method

Features: Tapered cups on piston's sides pass over cylinder parts, restrict exit flow. Back pressure

against piston causes rapid deceleration, asborbs shock at end of piston travel. Cylinders available non-cushioned, or with fixed or adjustable cushions. Fast return ball check available with adjustable cushions. Bronze rod bearing is lubricated from within. Wide spread between large-area bearings. Short mounting lengths. Single, double acting styles.

Specifications: Bore diameters from 1½" to 5". 1500, 3000 psi ratings.

Lanseair Development Corp.
Clintonville, Wisc.

Circle **300** on Time-Saver Card

CHECK VALVES . . . install in-line

Designation: Models VCL-F and VCL-P

Features: Cone type valves are spring-loaded. Designed for in-line installation.

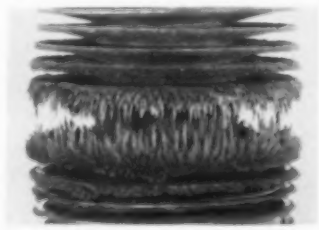
Specifications: Rated flow range is 3-50 gpm. Maximum operating pressure is 3000 psi; Cracking pressure, 5 or 65 psi. VCL-F has flare ends for connecting 37 deg. flared tubing. For ⅜"-1¼" OD tubing. VCL-P has female pipe thread ports in ¼"-1¼" IP sizes.

Parker-Hannifin Corp.
Cleveland, Ohio

Circle **301** on Time-Saver Card

MAGNETIC SUMP STRAINER . . . filters and traps

Features: All fluid in system passes through strainer. Removable filter discs filter non-magnetic matter; built-in Alnico permanent magnets trap magnetic matter. Reservoir



needs no extra openings. Sump strainers convert in field to magnetic models.

Ripley Screen and Strainer Co.
Farmington, Mich.

Circle **302** on Time-Saver Card

PIPE COUPLING . . . uses pipe-swelling method

Designation: Keelatite system

Features: Sleeve which mates with union and connector nut slips over pipe end. Sealed mandrel inserts into pipe bore. High pressure oil pumped through hollow mandrel swells pipe, retains sleeve.

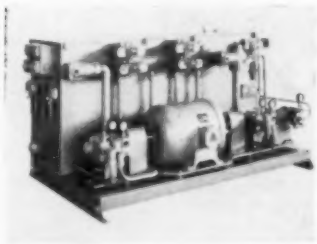
Industrial Hydraulics, Ltd.
Reading, England

Circle **303** on Time-Saver Card

HYDRAULIC POWER UNIT . . . is L-shaped

Designation: CircuitMaster

Features: Unit reduces amount of external piping and valve panels by 40%. With top removed, fluid from drain and return lines is visible while unit runs. Double-end



electric motor drives five pumping stations. High-low valve panels, solenoid relief valves control automatically. Unit shown powers core blower in foundry.

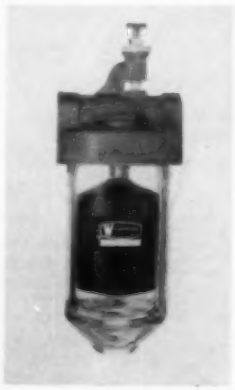
Double A Products Co.
Subs. Brown & Sharpe Mfg. Co.
Manchester, Mich.

Circle **304** on Time-Saver Card

AIR LINE LUBRICATORS . . . have quick-change bowl

Designation: Micro-Mist

Features: Touch of finger releases lock. Simultaneously, automatically, valve bleeds air from bowl. With



short twist, bowl comes off. No tools, no removal of screws, clamps, or rings.

Wilkerson Corp.
Englewood, Colo.

Circle **305** on Time-Saver Card

Continued on page 54

Jet brake cup — LS-53
Synthetic lube diaphragm — LS-53
Diesel equipment seal — Viton
Drop-off tank seal — LS-53
Chemical pump liner — Viton
Natural gas valve diaphragm — Viton

For advanced fuel...hydraulic...lube systems,

New materials prove ideal in handling temperature extremes −350° F. to +750° F.

Working with two remarkably versatile elastomers, C/R Sirvene engineers are producing flexible molded parts for many vital fuel, lubricating, hydraulic and pneumatic systems. One, Viton-A*, can be compounded to produce parts that function dependably at 600° F., and for short periods up to 750° F. The other important feature of Viton compounds is their excellent resistance to corrosive chemicals, chlorinated solvents as well as both synthetic and petroleum base fuels and lubes. At the other extreme, C/R compounded Silastic LS-53** parts are providing low temperature operation down to -80° F. They also exhibit excellent resistance to synthetic and petroleum base fluids up to 350° F., and function well in propane up to 500° F. For temperatures as low as -350° F., C/R recommends Teflon* compounds.

C/R Sirvene engineers have an intimate knowledge of these elastomers. They also have perfected special techniques in processing which still further improve the physical properties of the molded parts. If your problem involves high or low temperatures, close tolerances, and compatibility in advanced design fuel, lubricant or hydraulic systems, get in touch with us at once. We have the skill and the facilities to help you.

* DuPont registered trademark
**Dow-Corning registered trademark

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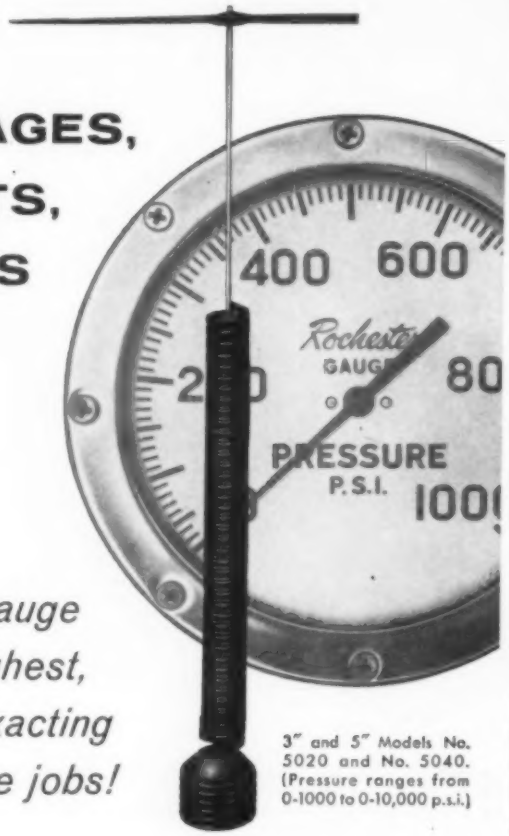
C/R

Revolutionary New ROCHESTER HIGH PRESSURE GAUGE
has pointer connected directly to pressure element

NO LINKAGES,
NO PIVOTS,
NO GEARS
to wear,
waver
or lag



This is the gauge for your toughest, your most exacting high pressure jobs!

3" and 5" Models No. 5020 and No. 5040. (Pressure ranges from 0-1000 to 0-10,000 p.s.i.)

Now you can practically eliminate maintenance, replacement, and gauge failures—even under the most severe of high pressure service conditions. The new RMC Gauge, models 5020 and 5040, actually approaches the reliability and dependability of the fittings and valves used in pressure equipment.

It is the first pressure gauge to have the pointer directly connected to the pressure element, without linkage or pivots, and with no gears or hair springs.

The pressure element is a multiple turn bourdon coil, to which the pointer is permanently attached at one end. As pressure increases, the end of the coil rotates, moving the pointer with it.

The bourdon coil is made from small diameter tubing. Therefore, the pressure forces against the coil are reduced; the mechanical stress on the coil is less; and spring life, cycling life, overpressure, and endurance are all vastly higher than the conventional "C" type bourdon tube gauge.

For safety, long cycling life and continued accuracy under extreme conditions of overload pressures, high vibration, shock and line pulsation, the new RMC High Pressure Gauge is the one complete answer. Available in pressure ranges from 0-1000 to 0-10,000 p.s.i.; dial diameters 1½", 2", 3" and 5". (1½" and 2" models are eccentric pivot-drive types.)

Write, wire or phone for complete information.

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LIQUID LEVEL, TEMPERATURE and PRESSURE INSTRUMENTS

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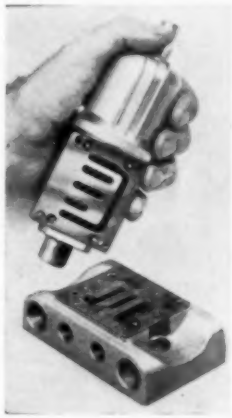
COMPACT AIR VALVES
. . . need no accessories

Features: Valve bodies, bases are prewired. Body plugs into base to complete electrical connections. Automatic, manual, or ball-type operators. Valves can be set to locked-



in or locked-out position. All solenoids are interchangeable among valves of same port size. Valves disassemble completely with screwdriver.

Specifications: 3-way, 4-way, and 4-way, 5-port valves in ¼", ⅜", and ¾" sizes.

Mechanical Air Controls
Oak Park, Detroit, Mich.

Circle **306** on Time-Saver Card

PISTON PUMPS
. . . generate to 10,000 psi

Designation: Racine-Seco Model HC-4

Features: Fixed-displacement radial pumps generate to 10,000 psi with same mechanical efficiency. Shaft rotates either way without reversal

Continued on page 56

Creative hydraulics by Sundstrand

Improve Your Mobile Equipment With These Transmission Characteristics

Custom-Designed Hydrostatic Transmissions

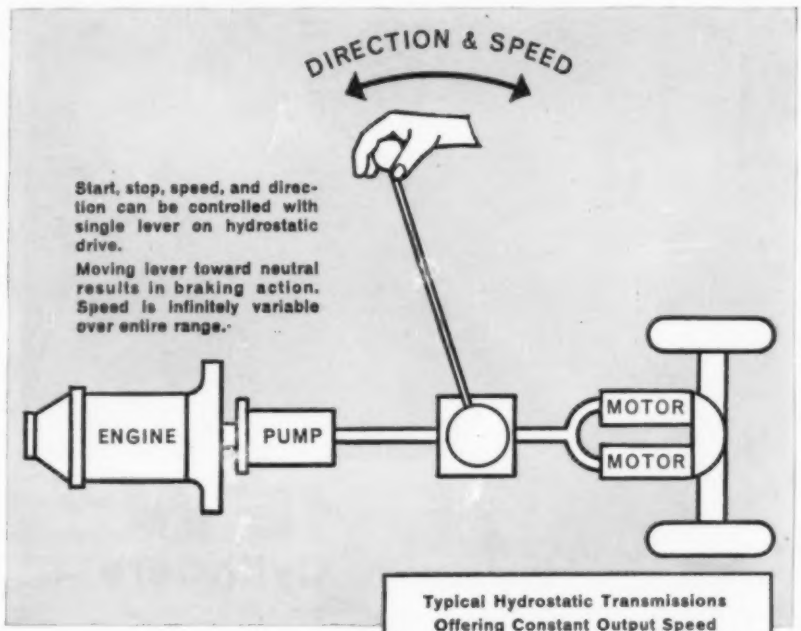
- **Single-Lever Direction and Speed Control**
- **Infinitely Variable Speed Control**
- **Automatic Torque Multiplication**
- **Variable Input, Constant Speed Output**
- **Nonslip Differential**

Hydrostatic drives simplify control of vehicle propulsion and auxiliary functions—provide other operating characteristics unattainable with ordinary power transmission or drive methods—all at sharply reduced maintenance levels.

The basic components of Sundstrand hydrostatic transmissions are axial piston pumps and motors of either variable or fixed displacement. Used in various combinations with Sundstrand valves and controls, they are custom-combined to give your equipment the precise operating characteristics you need for optimum performance and competitive sales advantage.

Typical applications for Sundstrand hydrostatic transmissions include: Alternator drives on construction and fire-fighting equipment, refrigeration compressor drives, fan drives in air conditioned buses, conveyor drives on agricultural, construction and mining equipment, and propulsion for many types of mobile equipment.

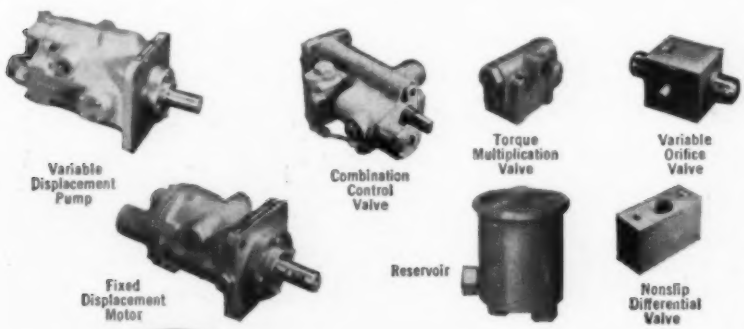
For complete details, send a brief outline of your requirements to the address below:


DIRECTION & SPEED
Start, stop, speed, and direction can be controlled with single lever on hydrostatic drive.
Moving lever toward neutral results in braking action. Speed is infinitely variable over entire range.
ENGINE
PUMP
MOTOR
MOTOR

Typical Hydrostatic Transmissions Offering Constant Output Speed

Output HP	Pump Input-Speed Range—RPM	Motor Constant Output Speed RPM ± 5%*
2 hp	300 to 3000	1200
3 hp	450 to 3000	1800
4 hp	600 to 2500	2400
6 hp	800 to 2400	3000
8 hp	850 to 2300	3300
9 hp	950 to 2200	3600

*Under normal rated load conditions, motor output speed can be held constant within ± 5%.



SUNDSTRAND

SUNDSTRAND HYDRAULICS

DIVISION OF SUNDSTRAND CORPORATION

2210 Harrison Ave., Rockford, Ill.—Eastern Sales Office: 89 Summit Ave., Summit, N. J.

NEW PRODUCTS

of oil flow. Pistons are honed to fit assemblies.

Specifications: Sizes from .3 gpm to 18 gpm. Use direct drive speeds to 3600 rpm.

Racine Hydraulics & Machinery, Inc.
Racine, Wis.
Circle **307** on Time-Saver Card

HYDRAULIC OIL
. . . has range of —65F to 350F

Designation: Anderol L-386

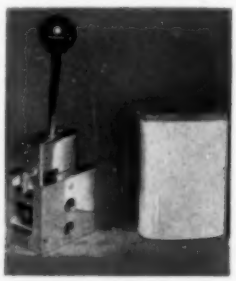
Features: Synthetic diester for hydraulic and pneumatic systems. Non-gumming, compatible with ordinary lubricants. Has low shear characteristics, built-in rust protection and anti-foam.

Specifications: Viscosity index is 206; evaporation rate, 5.1; temperature range, —65 to 350 F. No rust on steel and aluminum in humidity cabinet for 200 hours. Available in pint, quart, and gallon cans, 5 and 55 gallon drums.

Lehigh Chemical Co.
Industrial Lubricant Div.
Chestertown, Maryland
Circle **308** on Time-Saver Card

SMALL CONTROL VALVE
. . . for air or oil

Features: Spring-loaded poppets relieve at 125% of maximum valve pressure rating. Three and four-way porting. Handle load decreases as pressure increases. Same port area



as valves five times its size and weight. Pressure rating changed by adjusting springs.

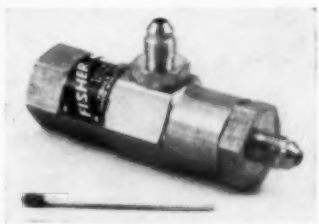
Specifications: Made in ⅛", ¼", ⅜", and ½" NPT. For air or oil service. Spring ranges from 28" Hg vacuum to 20 psi, 0 to 300 psi, 300 to 1000 psi, and 1000 to 1500 psi. Die cast aluminum bodies.

Gabriel Valve Div.
Gabriel Corp.
Cleveland, Ohio
Circle **309** on Time-Saver Card

GAUGE PROTECTOR
. . . for corrosive fluids

Designation: Series 101550

Features: Protector is for pressure systems using corrosive fluids.



Specifications: Maximum operating pressure is 10,000 psi; shut-off pressure from —10 to 6000 psi. Available in 28 combinations of inlet and outlet connections. Made of stainless steel.

Fisher Controls, Inc.
Santa Monica, Calif.
Circle **310** on Time-Saver Card

Continued on page 58

BHEW
Hydraulic Cylinders

- Basic Designs
- Specific Adaptations
- Superior Quality
- Application Engineering

BHEW SINGLE-ACTING GENERAL-PURPOSE CYLINDERS (1500 PSI DISPLACEMENT — RAM — STYLE SERIES) are designed around standard components but custom-built to suit *your* application. They're available in a variety of mountings (pin eye is standard) with adjustable or non-adjustable rod ends, with or without rod ends.

• Self-adjusting "U" cup seal on pistons • Self-adjusting rod wipers • Honed steel barrel, high-tensile, hard chrome-plated rod ends • Packings available for extreme high and low temperatures and most non-inflammable fluids.

Production parts save you money, do the job better! BHEW basic cylinders can easily be modified to fit your *specific* product applications. You benefit from production economies; you get custom-built cylinders.

Let's discuss your design and application problems —

FREE!
Write today for Hydraulic Cylinder Engineering Reference Data — 78 dimensional basic designs for general — and special-purpose double-acting cylinders. SAVE TIME.

BENTON HARBOR ENGINEERING WORKS, INC.
622 Langley Avenue St. Joseph, Michigan

Circle **26** on Time-Saver Card

YOU SHOULD TRY ELECTRUNITE

The welded hydraulic fluid line tubing that costs less to buy... is easier to bend and flare!

The big switch is on! Hundreds of equipment and machinery builders and their maintenance departments are using millions of feet of Republic ELECTRUNITE Hydraulic Fluid Line Tubing. The reason... *cost reduction.*

ELECTRUNITE costs *less* to buy (in all sizes shown in the JIC Standards Book and in an even wider range of sizes produced to our specification HL-1). Savings in downtime reflect still greater economics. *In the history* of ELECTRUNITE Hydraulic Fluid Line Tubing, no failure resulting from longitudinal or transverse cracks has been reported.

Add to that the fact that ELECTRUNITE is easier to bend and flare. This tubing is made from *high-grade, close-tolerance, flat-rolled steel.* Checked for defects as only flat-rolled steel can be checked. Then: formed, welded, annealed, cold-worked, and annealed again into a tube of unsurpassed uniformity, a tube that meets or exceeds the normal life of tubing produced by any other method.

See for yourself. Contact your ELECTRUNITE sales representative or mail the coupon for complete information, including a copy of specifications.

REPUBLIC STEEL
STEEL AND TUBES DIVISION

REPUBLIC STEEL

Cleveland 8, Ohio

MEETS ALL REQUIREMENTS OF THE JIC STANDARD!

ELECTRUNITE® is available in all sizes shown in JIC Standards Book. Available in a wider range of sizes produced to our specification HL-1 (which meets all test requirements of the JIC standard).

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION
DEPT. C-8267R
211 EAST 131st STREET • CLEVELAND 8, OHIO

Please send complete ELECTRUNITE Hydraulic Fluid Line Tubing information, including a copy of specifications.

Name _____ Title _____

Company _____

Address _____

City _____ Zone ____ State _____

NEW PRODUCTS

TANDEM HYDRAULIC PUMP
. . . 2 gear pumps on 1 shaft

Designation: Hydroid

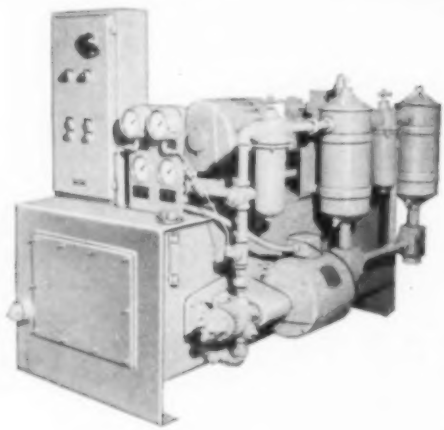
Features: Designed for construction machinery, off-road vehicles, and automated production equipment with multiple hydraulic circuits. Elliptical tooth form of pump impellers eliminates trapping between teeth and roots, lowers hp absorption.

Specifications: Larger pump of a construction machine model has rating of 60 gpm at 1800 rpm, 0 psi, and 56 gpm at 1800 rpm, 1500 psi. Smaller pump rating is 18 gpm at 1800 rpm, 0 psi, and 16 gpm at 1800 rpm, 1500 psi. Gear design permits speeds above 4000 rpm, flows of 250 gpm in larger pumps.

Hupp Aviation Co.
Div. Hupp Corp.
Chicago, Ill.

Circle **311** on Time-Saver Card

CARDWELL FORCED LUBRICATION UNIT



Provides high pressure wedge to float trunnion with continuous low pressure for lubrication and cooling.

Cardwell custom designs and engineers lubrication equipment to meet your specific job requirements, regardless of application, size and capacity. Write for descriptive catalog and further information.

The CARDWELL MACHINE COMPANY
Franklin at 19th St., Richmond 11, Virginia • Phone Milton 4-4593

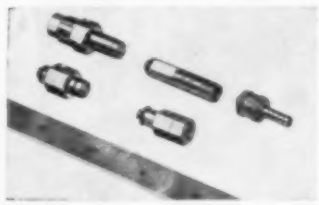
Circle **29** on Time-Saver Card

FLOW CONTROL DEVICES
. . . are miniature

Designation: Minimatic

Features: Air-oil devices are for automatic, semi-automatic tooling, jigs, dies, fixtures, and small, light, end-products.

Specifications: (Devices shown clockwise from top left) MFC-1 flow control is 1½" long. Offers



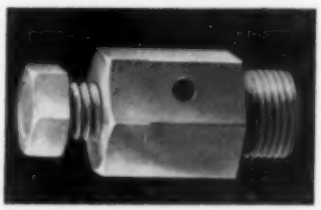
controlled flow one way, full flow return, at 0-250 psi. MQC-V check unit is 1-5/16" long; MQC-F hose connection, 1" long. Both work at 0-150 psi. MCV-1 check valve, 1" long, opens at 1 psi, holds 0-2000 psi. MNV-1 needle valve, 15/16" long, controls flow either way at 0-2000 psi.

Clippard Instrument Laboratory, Inc.
Cincinnati, Ohio

Circle **312** on Time-Saver Card

AIR BLEED VALVES
. . . for hydraulic systems

Features: When hexagon screw is loosened, stainless steel ball lifts, releases trapped air through bleed

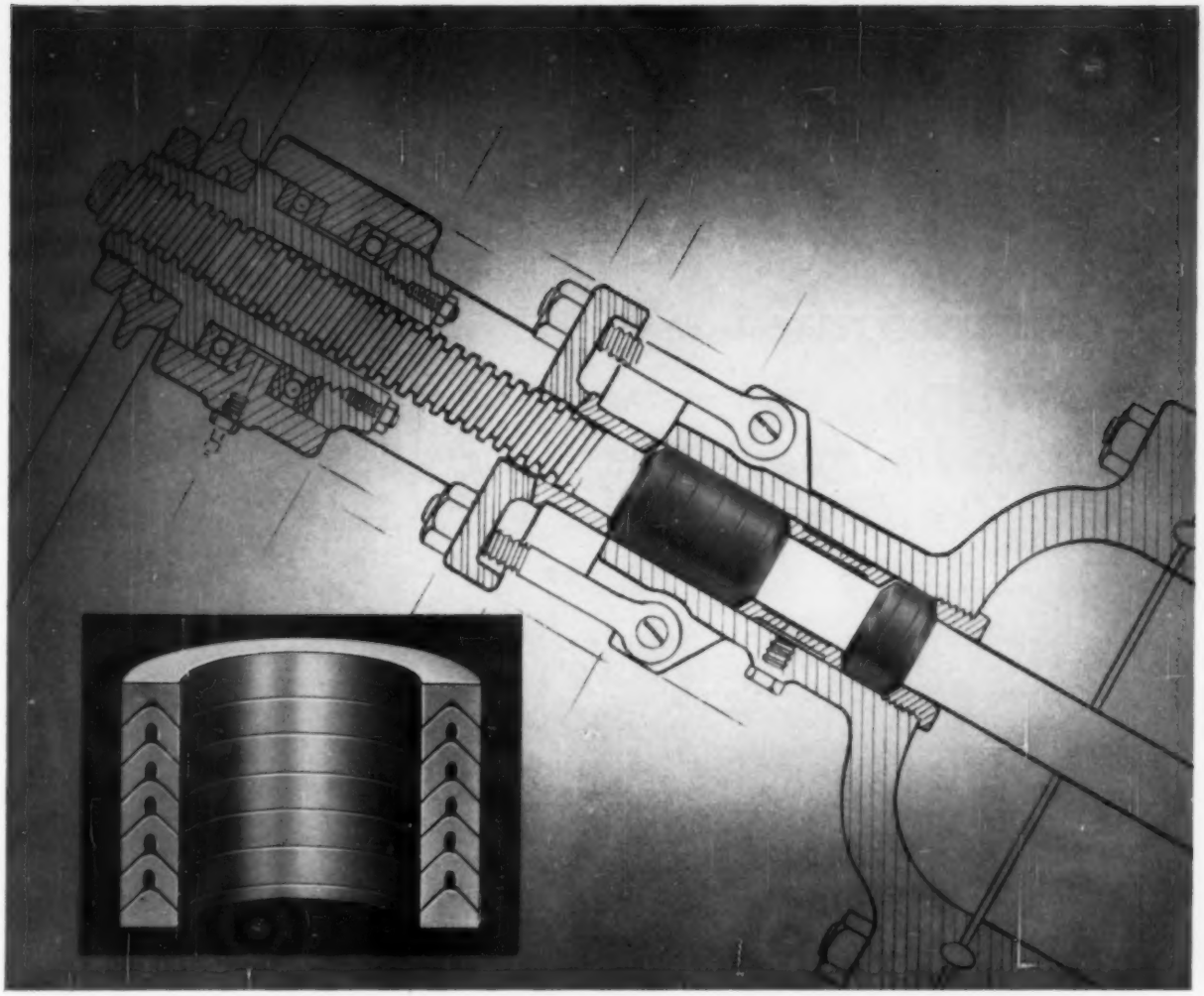


hole. Valves can be welded to pipes or cylinders. Some models have threaded ends in ¼", ⅜", and ½" BSP sizes.

Hydraulic Components Co.
Scarborough, England

Circle **313** on Time-Saver Card

Continued on page 60



Long life for valves in corrosive service made possible by V-ring packing of TFE resins

Paper mills encounter serious problems in packing valve stems in corrosive white, green and black liquor service. Ordinarily, frequent changes of packing and periodic adjustments are required; liquor losses occur; cleaning and maintenance costs are high. By switching to V-ring packing of Du Pont TEFLON TFE resins, frequent changes, adjustments and liquor losses are eliminated. And wear on valve stems is sharply reduced.

The outstanding properties of TFE resins—toughness, virtually complete chemical inertness, resistance to temperature extremes, low friction without lubrication—have led to their specification as sealing and gasketing materials even when service demands are not exceptionally rugged. The use of TFE resins permits full standardization . . . provides reliability, longer life and fewer maintenance problems.

For more information about the engineering properties of TEFLON TFE resins in a variety of sealing applications, write to: E. I. du Pont de Nemours & Co. (Inc.), Advertising Department, Room T-312, Nemours Building, Wilmington 98, Delaware.

In Canada: Du Pont of Canada Limited, P. O. Box 660, Montreal, Quebec.

DU PONT **TEFLON®**

TFE-FLUOROCARBON RESINS

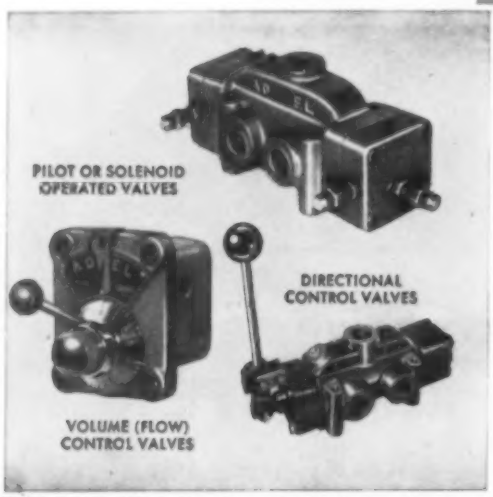
BETTER THINGS FOR BETTER LIVING . . THROUGH CHEMISTRY

TEFLON is Du Pont's registered trademark for its fluorocarbon resins, including the TFE (tetrafluoroethylene) resins discussed herein.

ADEL Automates your manual machines *with Industrial Hydraulic Components*

Modernize and automate your existing machines with ADEL Hydraulic Pumps, Motors and Control Valves. Machine builders for the industrial, construction and agricultural fields specify ADEL components as standard equipment.

GEAR-TYPE HYDRAULIC PUMPS



ADEL Hydraulics' experience in the design, development and precision production of hydraulic equipment has produced components of unusual reliability, efficiency and economy. These proven Pumps, Motors and Control Valves, available in a wide variety of types, sizes and mountings, may mean new economies in your hydraulic system costs.

Complete engineering specifications are available upon request.

DISTRIBUTORS:

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Air-Draulics Company
3135 N. 29th Ave., Phoenix

CALIFORNIA
Teglen Engineering Co., Inc.
1942 Huntington Dr., So. Pasadena

COLORADO
E. C. Wild Company
1163 So. Cherokee St., Denver

CONNECTICUT
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ILLINOIS
Catching Engineering
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INDIANA
Neff Engineering Company
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Tri-State Supply Co.
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3207 Cambridge St., Toledo
Wyatt Sales Corporation
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OREGON
Ray Bobbs Air-Draulics Inc.
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PENNSYLVANIA
Airline Equipment Co., Inc.
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Frank T. Donnelly Company
P. O. Box 11527, Pittsburgh 38

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WISCONSIN
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Milwaukee 17

Reliability
ADEL PRECISION PRODUCTS
A DIVISION OF GENERAL METALS CORPORATION

1444 WASHINGTON AVENUE, HUNTINGTON 4, WEST VIRGINIA

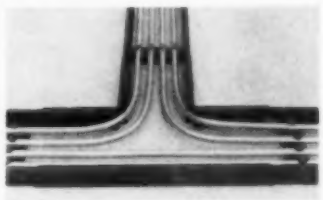
Circle **3** on Time-Saver Card

NEW PRODUCTS

TUBE RACK
. . . in ten-foot lengths

Designation: Series 5

Features: Rack is openly accessible from above or below. Each ten-foot length has two boltless splice plates.



Specifications: Racks available in aluminum, steel, or aluminized steel. Parallel siderails are ½" x 2". Cross rungs, 12" apart, are ⅜" x 1¾". Loading depth is 1¼".

Chalfant Products Co.
Cleveland, Ohio

Circle **314** on Time-Saver Card

CONSTANT VOLUME REGULATOR
. . . has micrometer adjustment

Features: Regulator gives constant-volume air or gas output, regardless of fluctuating pressure drop.

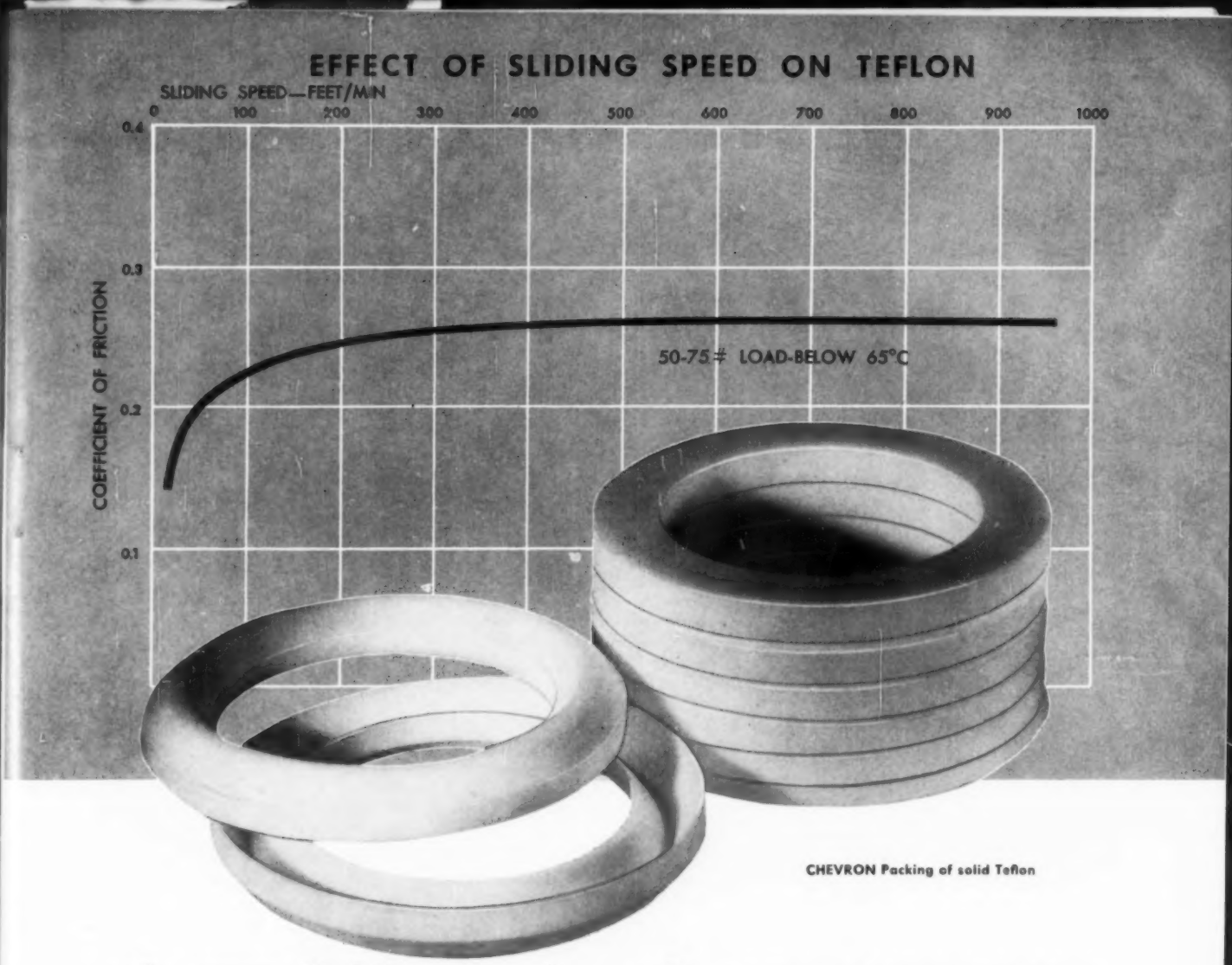
Micrometer adjustment controls capacity.

Specifications: Regulator has brass body. Output volume from 5.0 to 180 scfh.

George W. Dahl Co., Inc.
Bristol, R. I.

Circle **315** on Time-Saver Card

For more NEW PRODUCT reviews turn to page 118



CHEVRON Packing of solid Teflon

wherever fluid power is used—GARLOCK PACKINGS OF TEFLON* MAKE A BIG DIFFERENCE IN EFFICIENCY

Friction, wear practically eliminated. Garlock CHEVRON† Packings of solid Teflon—or coated with Teflon—are as close to "frictionless" as you'll find. First of all, Teflon has the lowest coefficient of friction of any solid material in use today. Moreover, the CHEVRON itself is designed to permit free operation with minimum friction at all pressures. Here's how: with increasing pressures, CHEVRON Packing rings tighten to prevent leakage. As pressures decrease, the rings instantly ease off, permitting free operation of the rod, ram, or piston without leakage. This exclusive hinge-like construction lengthens packing life and, with proper installation, eliminates all further adjustments necessary to compensate for pressure variations.

Teflon-coated Cups reduce breakaway torque, completely eliminate "squealing."

Teflon-coated Cups, Teflon "V" Rings, "O" Rings wear longer, reduce friction, are tough, resilient. Solid-Teflon packings are chemically-inert, non-flammable, can be applied against all hydrocarbons and new synthetic hydraulic fluids at temperatures ranging from −100°F to +500°F.

Discuss Garlock Teflon Packings with your local Garlock representative. Call him, or write for Catalogs AD-115 (CHEVRON Packings), AD-148 ("O" Ring Packings), and AD-145 (Molded Cups).

THE GARLOCK PACKING COMPANY, Palmyra, N. Y.

For Prompt Service, contact one of our 26 sales offices and warehouses throughout the U.S. and Canada.

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Molded and Extruded Rubber, Plastic Products

*DuPont Trademark for T.F.E. Fluorocarbon Resin
†Registered Trademark

Canadian Division: The Garlock Packing Co. of Canada Ltd.

Plastics Division: United States Gasket Company

USEFUL LITERATURE

For your free copy of publications reviewed, fill in the reader service card

RING PACKING HAS T CROSS-SECTION

Packing is a resilient sealing ring, molded from natural or synthetic rubber compounds into T cross-section. Two non-extrusion rings on each side support ring. Ring installs into groove in piston or around rod. Can serve as static seal. Resists destructive deformation. Seals without extrusion against 10,000 psi, at temperatures from —70 to 600 F. Bulletin GTR-759 provides selection charts, application suggestions, order instructions. *Greene, Tweed & Co., North Wales, Pa.*

Circle **400** on Time-Saver Card

WIRE CLOTH FILTERS

Wire cloth filters are woven from stainless steel. Provide increased area, improved drainage, decreased weight, minimum-size envelopes. Convolution of cloth eliminates breakage at folds. For differential pressures to 4500 psi. Absolute filtration of 15 microns. Bulletin has specification tables, graphs of flow vs. pressure drop characteristics. *Purolator Products, Inc., Rahway, N. J.*

Circle **401** on Time-Saver Card

TEMPERATURE REGULATORS

Regulators automatically control flow of heating or cooling fluids. Liquid in thermostatic bulb vaporizes with temperature increase, liquid pressure transmits vapor pressure to control valve's bellows. Iron or bronze bodies. Temperature ranges from 100 to 310 F. Single seated valves in sizes ¼"-2"; double seated, ¼"-5". Bulletin 7-1 contains table of dimensions and weights, drawings, capacity and pressure rating charts. Control applications and eight body styles illustrated. *A. W. Cash Valve Mfg. Corp., Decatur, Ill.*

Circle **402** on Time-Saver Card

VALVES SET BY COLOR CODE

Colored rings on micrometer adjustment shaft allow even inexperienced personnel to read, pre-set valves. Flow control, check, and needle valves. O-ring seal with Teflon back-up seals thread from fluid. Locking screw prevents field tampering. Positive needle valve stop prevents blow-off. Guided stem accurately seats poppet. Stem and poppet are stainless steel. Positive poppet stop prevents spring damage. *Manatrol Corp., Cleveland, Ohio.*

Circle **403** on Time-Saver Card

VALVES & FITTINGS

High-pressure pipe-size valves and fittings have lens-ring gaskets, union-type joints. Gaskets are self-energizing. Increase of internal pressure tightens pressure seal. Pressure systems assemble in minutes. Repeated assembly, disassembly doesn't damage joint. Bulletin 4072 describes preparation of joints, lists line of lens-ring gasket valves, elbows, tees, and cross-type, socket weld, and special purpose fittings. *American Instrument Co., Inc., Silver Springs, Maryland.*

Circle **404** on Time-Saver Card

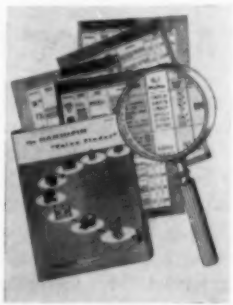
COMPRESSOR BULLETIN

Bulletin SG-2 covers single and two-stage compressors. YC 2-cylinder, 2-stage models available in sizes from 1½ to 15 hp. Pressures of 125, 175, and 250 psi. YS 2-cylinder, single-stage models are air-cooled, available in sizes from 1½ to 10 hp. Designed for continuous operation at 80 psi. YC and YS models have built-in positive starting unloader, forced-feed lubrication, and low oil level protection. Both designed for constant speed, start-stop, or dual control operation. Single-cylinder, single-stage model G is air-cooled. Available in ½, ¾, and 1½ hp sizes. Pressures of 80, 100, and 150 psi. Ball bearing crankshaft suspension. Bulletin discusses parts and accessories. Complete specifications. *Le Roi Div., Westinghouse Air Brake Co., Milwaukee, Wis.*

Circle **405** on Time-Saver Card

CAPACITY COEFFICIENT FLOW DATA

Bulletin 234 gives maximum, minimum capacity coefficients (flow factors) for directional air control valves. Figures taken from laboratory measurements of air flow rates through production



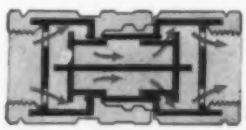
valves. Includes index of air flow capacity by valve port sizes. Ratings permit choosing proper valve size for any application. Bulletin has data application formula, and sections on valve terms and principles. *Hannifin Co., Division Parker-Hannifin Corp., Des Plaines, Ill.*

Circle **406** on Time-Saver Card

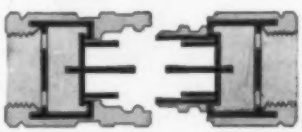
For more reviews of FREE LITERATURE turn to page 124

There's a size and type to handle almost anything that flows

TO USE SNAP-TITE VALVED COUPLING:



CONNECT—Full flow instantly



DISCONNECT—No flow instantly

Snap-Tite can provide the right size valved coupling for most any use . . . with quick off-on action wherever coupling or shut-off is required.

"H" series valved couplings for high pressure applications. High resistance to heavy line surge. Sizes from 1/8" through 6". Larger sizes on special order.

"IH" series valved couplings for greater impact in air lines. 1/8" through 1/2".

"E" series valved couplings for vacuum and very low pressure. Recommended for gravity flow. Sizes from 1/8" to 6". Larger sizes on special order.

"T" series valved couplings for hard to handle fluids. The only valved quick-disconnect couplings now on the market for fluid temperatures from −40°F to +400°F. Sizes from 1/2" through 3".

Snap-Tite valved couplings are available with two-way or one-way automatic line shut-off. They are normally furnished in alloy steel. Also available in brass, aluminum, or stainless steel with a variety of finishes.

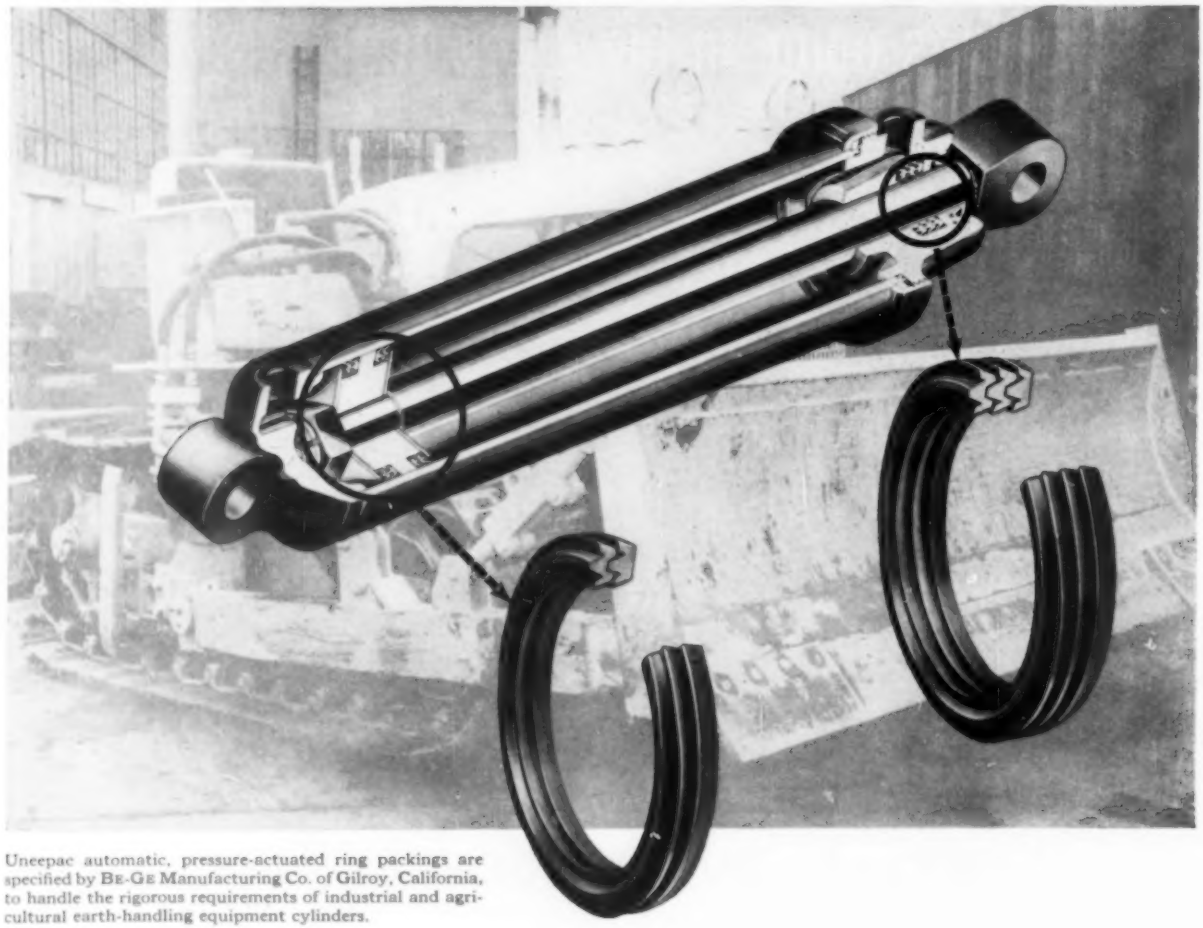
Write for Snap-Tite Catalog No. 58 for more information on Snap-Tite valved couplings.

★Snap-Tite

UNION CITY 1, PA.

ST-59-02

Rigorous tests convinced BE-GE to use J-M Uneepac® in their rugged cylinders



Uneepac automatic, pressure-actuated ring packings are specified by BE-GE Manufacturing Co. of Gilroy, California, to handle the rigorous requirements of industrial and agricultural earth-handling equipment cylinders.

Uneepac proves it can handle shock pressures to 4,000 psi in three-year, life-test program

• BE-GE Manufacturing Company's line of cylinders for their hydraulic systems has to stand up to years of day-in, day-out abuse. That's why BE-GE engineers subjected J-M Uneepac Rod Packings to a 350,000-cycle test and Uneepac Piston Packings to a 150,000-cycle test in a three-year program that proved Uneepac can take working pressures to 2,500 psi—shock pressures to 4,000 psi. As proof of performance, Uneepac is now the specification packing on all BE-GE standard—and heavy-duty cylinders.

Pressure-actuated Uneepac Rings offer high-efficiency sealing in minimum packing depth. Each ring provides an efficient, individual seal—nests with adjacent rings in an interlocking manner without compression adjustment for true, multiple-ring action.

With Uneepac, you can achieve high-efficiency sealing with fewer rings, smaller stuffing boxes. For quick, easy installation, Uneepac rings are self-centering, self-adjusting. Make it a point to consider Uneepac Rings for every application requiring top packing efficiency and life.

Uneepac rings are available in all standard materials in a wide range of sizes for most rod and plunger applications. For further information, write to Johns-Manville, Box 14, New York 16, N. Y.

J-M Clipper Seals—used as rod wipers in BE-GE cylinders—keep dirt out.

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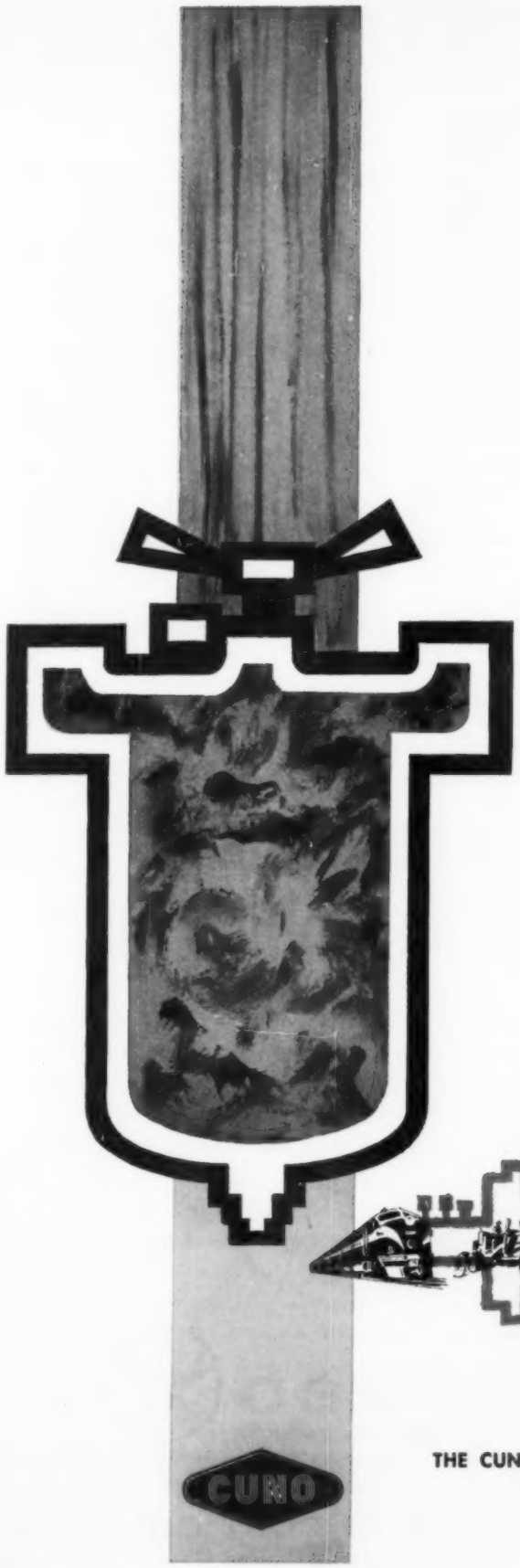

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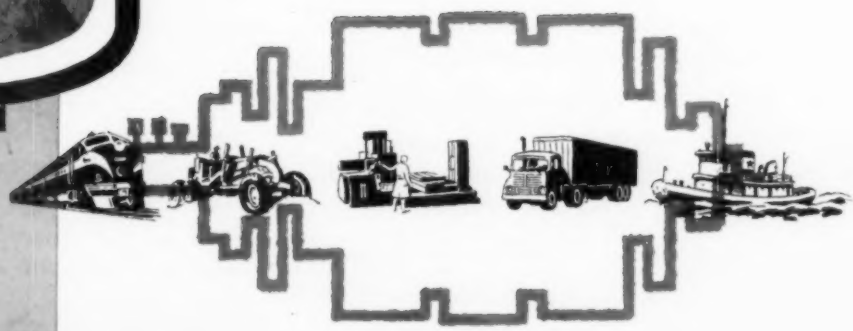

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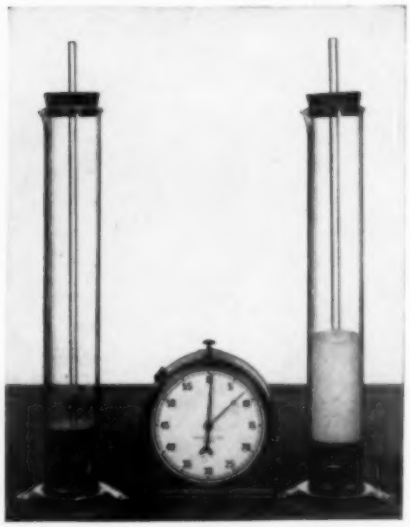
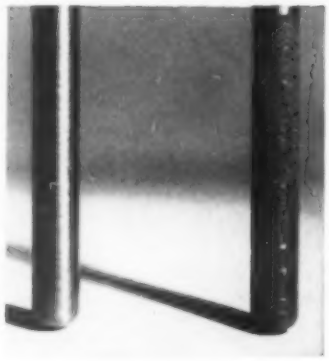
1,000-hour oxidation test shows that the coil (at left) immersed in Texaco Regal Oil R&O is free of the gum and varnish deposits which occur with an oil not fortified against oxidation (right coil).





ASTM Foam test shows that Texaco Regal Oil R&O has already depressed foam, only 480 sec. after air bubbles were forced through it. Severe foaming persists in cylinder of uninhibited oil at right.

In ASTM rust test, rust-free spindle was immersed for 24 hours in a circulating mixture of Texaco Regal Oil R&O and salt water. Severely rusted spindle (right) was run in same test using an oil not inhibited against rusting.

Here's why Hydraulic Performance is better with Texaco Regal Oil R&O

The tests pictured above show that you can count on Texaco Regal Oil R&O to give you the three vital properties you need in a hydraulic oil: oxidation resistance, rust prevention, and anti-foam action. These properties keep your hydraulic equipment performing predictably, dependably, every hour, every day with –

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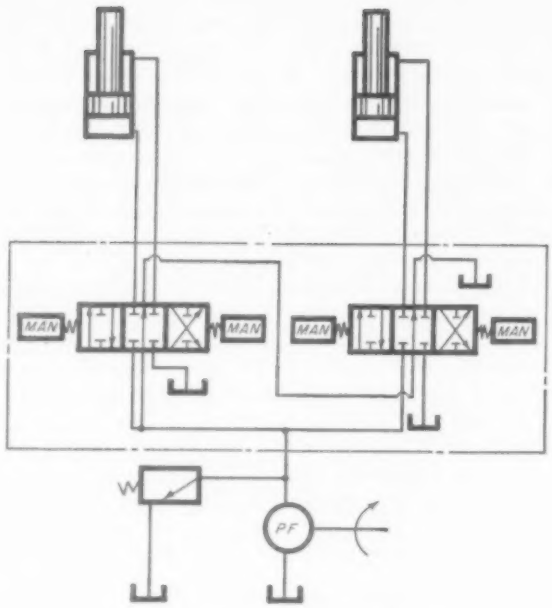
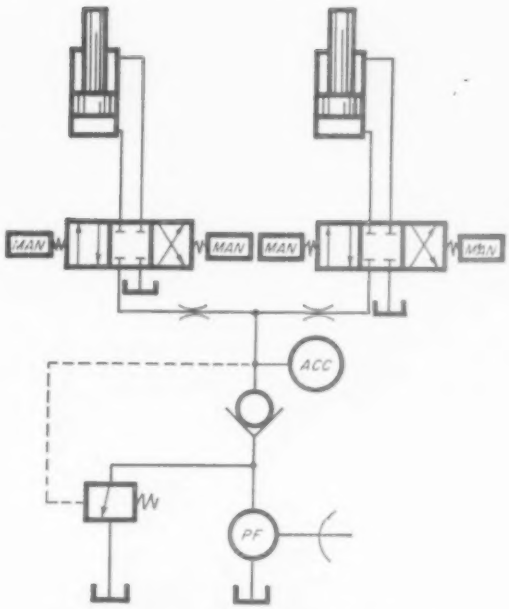


open center



closed center

How do they compare?

● By **K. V. KIRKPATRICK,** *Assistant Chief Engineer, Mobile Hydraulics Div., Vickers, Inc., Div. Sperry Rand Corp., Detroit, Michigan*

Designers of earthmoving, construction, and materials handling vehicles have been taking a closer look at closed-center hydraulic systems. Their advantages have been especially emphasized in proposals for new systems. Here is how they compare with more conventional (for mobile equipment) open-center systems. A basic hydraulic circuit, of a type commonly used in the mobile field, offers an excellent base for system comparison.

THE TERMS "open center" and "closed center" applied to hydraulic systems are taken from the neutral position porting of the directional valves which control them.

There are other differences too.

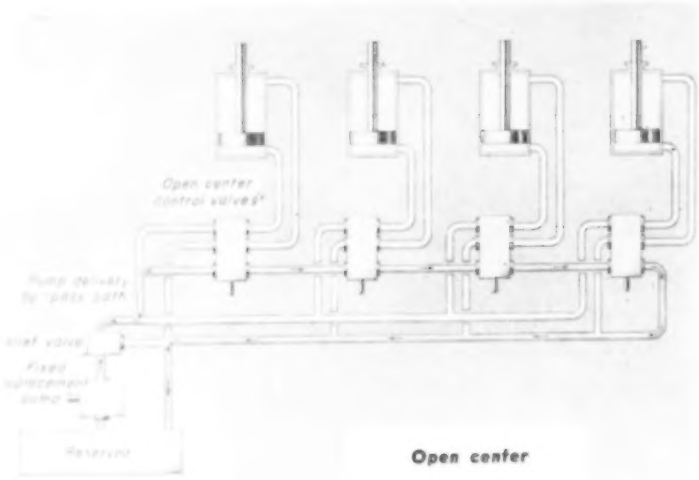
In a open-center system:

- ► *Pump pressure is determined by cylinder force requirements. It is nearly zero when no force is needed.*
- ► *Pump delivery is not directly determined by cylinder speed requirements.*
- ► *Cylinders or motors are sized to meet speed requirements with pump delivery.*

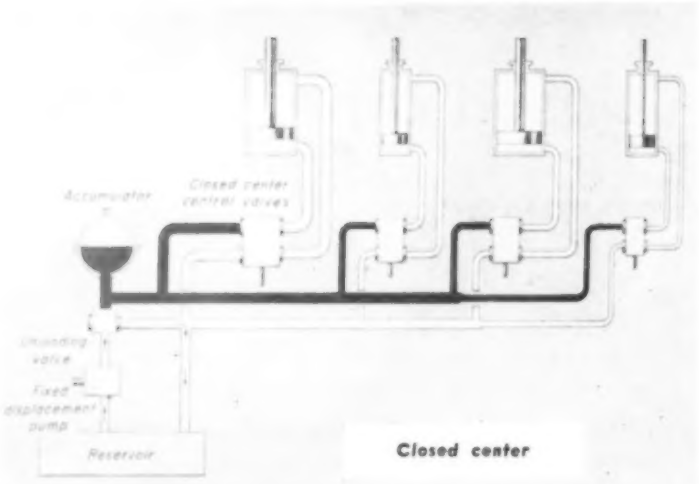
In a closed center system:

- ► *Pump pressure is not directly determined by force requirements; it is essentially near maximum.*
- ► *Flow from the power source is determined by speed requirements.*
- ► *Cylinders or motors are sized to meet force requirements with nearly constant pressure system.*

OPEN CENTER-CLOSED CENTER



Open center



Closed center

SMALLER CYLINDERS in this closed center system permit smaller directional control valves. Pump size is based on time available for re-charging the accumulator. A pressure-compensated, variable delivery pump may also be used in the closed center system.

• **Open center features**—In an open center system, the directional valves not only port fluid flow to the actuators, but also unload the pump through bypass ports when they are in neutral. These bypass ports must all be equally large to pass full pump delivery with low pressure drop. The passages which direct fluid to the cylinders in the valve's shifted position must also be sized according to pump delivery for low pressure drop. The same is true for the system fluid lines.

Because cylinders are sized according to pump delivery and required cylinder speed, as well as force required, they are usually larger than in a corresponding closed-center system.

Cylinder speed is controlled by restricting fluid flow with a metering circuit. This uses either the throttling characteristics of the directional valve or a separate flow control valve. The restriction forces excess pump delivery to be bypassed to tank at some pressure loss resulting in wasted energy.

To avoid this power loss, two or more pumps have been used in both mobile and industrial systems. If a system has two cylinder circuits, requiring much different flow rates, two single pumps or one double pump can supply the required flow for each cylinder.

• **Closed center features**—The closed center systems described here have either an accumulator and fixed displacement pump or a pressure-compensated pump. In the accumulator system, the primary function of the pump is to charge the accumulator which supplies fluid to the system on demand. When the accumulator is fully charged, an unloading valve bypasses pump flow to tank at very low pressure. Bypass ports in the directional valves are not necessary, and the valves are closed center type. Maximum volume demand of the system determines capacity of the accumulator.

The pressures at which the unloading valve closes to begin charging the accumulator, and opens to unload the pump determine the accumulator's operating pressure range. How much of the total accumulator capacity is used depends on the pressure range—the greater it is, the more of the accumulator capacity used.

Capacity of the fluid supply depends primarily on maximum volume demand of the system. This determines the size and number of accumulators and the unloading valve pressure differential. Pump size is based on time available to recharge the accumulator. If the system demands fluid when the accumulator is discharged, the pump has to supply it alone.

Work load and system pressure determine cylinder bore size in a closed-center system. This is one of the system's most important features because in many cases it permits smaller and lower cost cylinders than in a corresponding open-center system.

Instead of a fixed displacement pump and accumulator arrangement, a pressure-compensated, variable displacement pump can be used as the power source in a closed center system. This pump adjusts its delivery according to system volume demands at a pre-

selected maximum pressure. The pump must be able to deliver the system's maximum flow demand. When there is no demand, all directional valves are in neutral, pump delivery is blocked by the closed ports. The pump is at minimum displacement. It supplies make-up fluid and maintains pressure.

• **Leakage control**—When closed center valves are in neutral, the blocked ports are at maximum system pressure, and they may leak. If there is an accumulator, leakage must be limited to hold the accumulator charge, especially if the pump is unloaded while the accumulator is charged. The unloading valve is another possible leakage point. In the variable displacement pump arrangement, any leakage at valve pressure ports is made up by the pump at system pressure. The higher the leakage rate, the greater the power loss.

In an open center system with all valves in neutral, system pressure is nearly zero. Accordingly, the only point of possible leakage is at the directional valve cylinder ports.. Even then, it is only important if the cylinders must remain locked in place. This, of course, is also true in the closed center system.

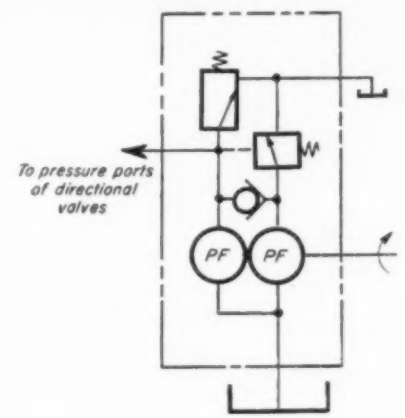
• **Speed control**—Metering to control speed is very different in open and closed center systems. In the open center system, slow, manual shifting of a valve gradually increases pressure from zero to work pressure as the valve bypass port closes and its pressure port opens.

In the closed system, pressure is always applied at the valve's pressure port, so as the valve shifts to a metering position, it releases pressure fluid into the cylinder circuit. This can cause a higher reaction force on the valve plunger than in an open center system. This effect must be considered in designing closed center valves.

When metering in the open center system, something less than pump delivery is being used. Excess pump delivery is bypassed and power is wasted. If a flow rate, relatively low in relation to pump delivery, is required for long periods of time, the closed center system is more efficient.

• **Actuator design**—Size is the main difference in actuators for the two systems. Cylinders and motors in an open-center system are sized for required speed with available pump delivery. Working pressure which is developed is a function of the load and the cylinder's bore. The pressure can vary for the various cylinder loads, and can be any value up to the relief valve setting.

Cylinders and motors in a closed-center system are sized according to the load and available system pressure. Speed is controlled by metering. The average size of cylinders and valves in a closed center system is smaller than in a corresponding open-center system, unless all cylinders must move at the same rate and carry equal loads. Each cylinder circuit is individually designed for a specific force and speed requirement independent of other circuits in the system.



• **HI-LO PUMP SYSTEM** works well where a cylinder must move first at high speed and low pressure, and then at low speed and high pressure. An open center system with this pump arrangement has little wasted energy. Both sections of the double pump deliver during the high speed stroke. With increased resistance on the cylinder, pressure rises and opens the unloading valve. This unloads one pump section while the remaining one continues to supply the low speed, high force part of the stroke. Frequently, the pump section which is unloaded is larger than the one which supplies the high force stroke. The arrangement may be assembled from two separate pumps, or it is available in a single housing combining unloading, relief, and check valves.

An open center system has a simpler fluid energy source consisting of a fixed displacement pump driven at constant or variable speed, and a reservoir. The pump-accumulator arrangement or pressure-compensated, variable delivery pump of the closed center system are more complicated, larger, and more costly. However, the accumulator system permits using a smaller pump.

• **Which system is best?**—Generally, the more individual circuits there are in a system, the more preferable a closed center design. Specifically, the closed system is preferred when there is great difference in flow rates between circuits, and a large number of such differences.

Because of the present availability of standard components, the open center system is easier to work out. But closed systems *can* be built from standard components.

With the wide use of open center components on mobile equipment, they are easier to get. Development of closed center components is going on and will increase as these systems replace multiple systems like hydraulic, air, and electric systems in buses and cars. With successful applications on these vehicles, new areas will open for applying closed center systems. ▼▼▼

Selecting flexible hose for fluid

• By D. WENDELL FENTRESS, *Vice President, Research & Development Flexonics Corp., Elgin, Illinois*

DESIGN OF FLEXIBLE HOSE

	Synthetic Hose	Metal Hose
Material	Chloroprene (Neoprene)* Butadiene-Acrylonitrile (Buna N)* Butyl Rubbers Thiokols Silicone Rubbers Fluorinated Rubbers (Viton A, Kel-F) Polyethylene Nylon Polytetrafluoroethylene (Teflon) Polyvinyl Chloride Other Thermoplastics	Carbon Steels† Stainless Steels† Monel† Phosphor Bronze† Brass† Aluminum† Hastelloys Inconel Berillium Copper Incoloy 901 A-286 Rene 41
Construction Features	Hose consists of inner tube, reinforcement, and cover.	Performance depends on wall thickness, convolution form, and depth and frequency of convolutions.
Reinforcement	Wire, cotton, rayon braid to prevent radial stresses and hose elongation under pressure. Braid angle is usually 35° with a line normal to the hose axis. Spiral wrap wire—Layers helically wrapped in alternate directions.	May have wire braid cover to prevent hose elongation under pressure. Performance depends on diameter and number of braid wires, braid angle (usually 45° to 50° with a line normal to the hose axis), percent coverage, and matreial.
End Fittings	Wide variety available including threaded nipples, swivel nuts, flanges, weld ends.	Same as for synthetic hose.

* Most common compounds

† Standard Types

TYPICAL BURST PRESSURES FOR HYDRAULIC HOSE

Nominal I. D. Inches	TYPE OF HOSE					
	SYNTHETIC			METAL		
	Low (1) Pressure PSI	Medium (2) Pressure PSI	High (3)* Pressure PSI	Low (4) Pressure PSI	Medium (5) Pressure PSI	High (6) Pressure PSI
1/4	5000	12000	20000	12700	18600	31000
3/8	4500	9000	16000	6700	13800	25700
1/2	4000	8000	14000	5870	12400	27500
3/4	3000	6000	9000	4600	8200	17500
1	2250	3200	7500	2580	6250	
1 1/4	1500	2500	6500	1970	5200	
1 1/2	—	2000	5000	1680	4350	
2	—	1400	4500	1920	3540	

(1) SAE 100R3 reinforced with 2 fiber braids.

(2) SAE 100R5 reinforced with 1 fiber braid, 1 wire braid.

(3) SAE 100R2 reinforced with 2 wire braids.

(4) Stainless Steel Hose reinforced with 1 wire braid.

(5) Stainless Steel Hose reinforced with 1 wire braid.

(6) In development. A wide range in wall thickness has been corrugated experimentally. Burst pressures well in excess of values shown can be obtained with heavier braid structures.

* Minimum burst pressures for "spiral wrap" synthetic hose are 150% to 250% of values for SAE 100R2.

power systems

PRESSURE is the first consideration in selecting hose for hydraulic service. The questions a designer must ask (and answer) are:

- What is the operating pressure of the system?
- What peak pressures does it produce?
- Is there cycle shock or impulse?
- How much pressure drop is allowed through the hose?

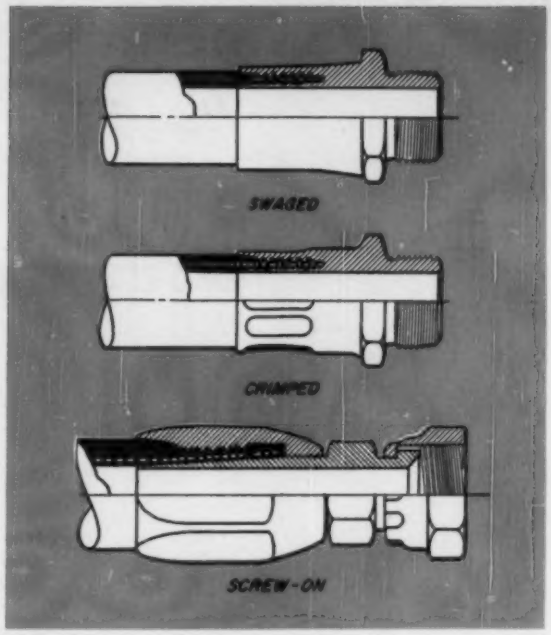
Hose is usually selected with a safety factor of 4:1. That is, minimum burst pressure is four times operating pressure. Pressure surges resulting from rapid valve operation and sudden stops are hard on hose. If these surges are repeated often enough, they can stress the system so it fails. Synthetic rubber hoses are resilient enough to absorb the shock loading, but metal hose reacts differently to pressure impacts and must be designed especially for such service. Conventional metal hose fails from fatigue under shock, but a newer design of corrugated metal hose has given excellent life when impulsed at peak pressures of 4500 psi. In fact it can now qualify under the most advanced military specifications issued by our Air Force for hydraulic tubular components.

• **Hot and cold**—The second factor which the designer must consider is temperature: operating temperature range of the fluid, ambient temperature, and storage temperature. These affect metal hose less than synthetic hose.

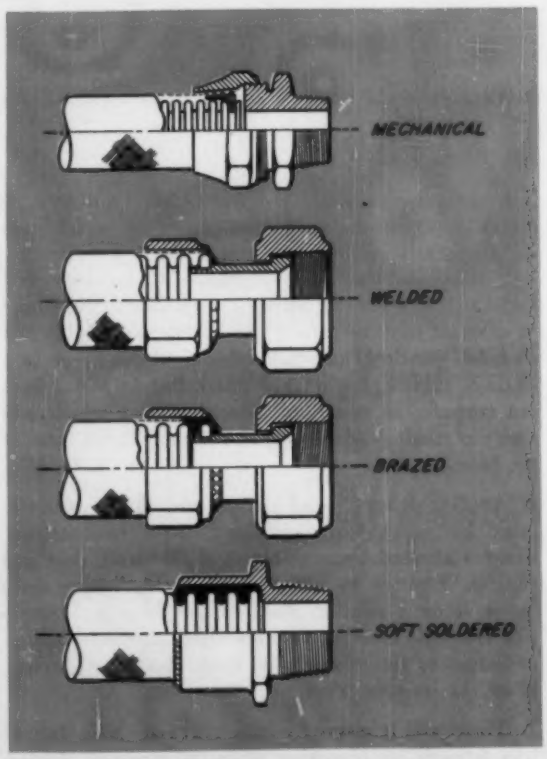
Synthetic rubber hose deteriorates fast at temperatures above 250 F. The rubber "over-cures" and becomes brittle, cracking or powdering. Below —40 F, rubber compounds crystalize and become brittle, and some of the elastomeric properties are lost even when they heat up again.

Ordinary rubber can be compounded only for a range of about 300 degrees, so a hose may be good for —65 F to 200 F, or for 0 F to 300 F intermittent operation, but not for —65 F to 300 F. Fluorinated rubbers such as Viton A are good for 0 to 400 F. Below 0 F, they become stiff and crack. Some silicone elastomers are good from —100 F to 500 F, but they have low tensile strength and high compression set and creep. Both fluorinated and silicone rubbers crystalize irreversibly at low temperatures. Teflon is useable over a range of —300 F to 500 F.

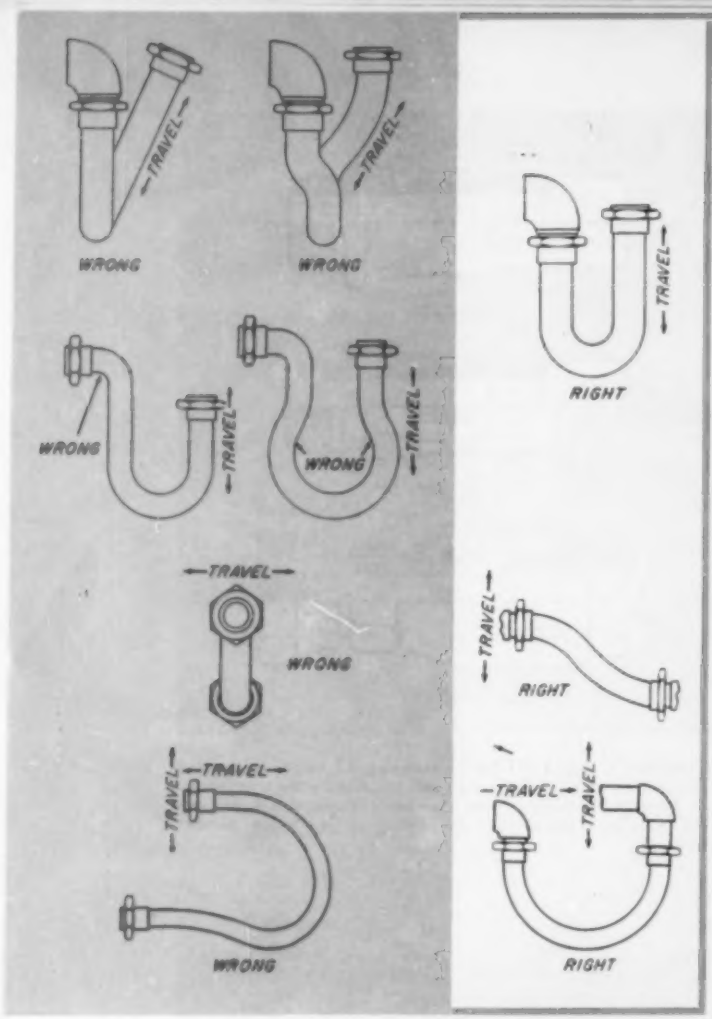
• **Hose must suit the fluid**—Hydraulic hoses have to handle petroleum base oils, synthetic fluids, water and oil solutions, emulsions, and dispersions. Teflon is the only material which works with all of these.



SYNTHETIC HOSE FITTINGS are swaged, crimped or screwed-on (reattachable). The leakage seal is made by the compression fit between the inner fitting member and the soft hose bore. The metal-to-braid grip of the fitting on the braid prevents blow-off.



METAL HOSE FITTINGS are attached mechanically or by welding, brazing, or soldering. The method depends on temperature, pressure and fluid of the application.



INSTALL FLEXIBLE HOSE to avoid sharp bends and torque during movement.

SPECIFICATIONS FOR FLEXIBLE HOSE

Military Specifications

MIL-H-8794 (formerly MIL-H-5511), Medium Pressure Rubber Hose

MIL-H-8788 (formerly MIL-H-5512), High Pressure Rubber Hose

MIL-H-25579, Medium Pressure Teflon Hose

SAE Specifications

SAE 100R1 through 100R5, Synthetic Hydraulic Hose

Aircraft Recommended Practices

ARP 601* } Metal Hose for Aircraft
ARP 602* }

ARP 604* Teflon Hose for High Pressure

* To be released

HYDRAULIC IMPULSE TEST RESULTS
½" HYDRAULIC HOSE

Hose		Pressure psi		Number of Cycles Attained
Type	Designation	Operating	Peak	
Synthetic	SAE 100R3	1000	1250	100,000-150,000
	SAE 100R5	2000	2500	150,000-200,000
	SAE 100R2	3000	4500	125,000-175,000
Metal	Stainless Steel 1-Wire Braid	3000	4500	1500-3000
	Concluding Development	3000	4500	150,000-200,000

Note: Testing performed to MIL-H-8788 except temperature advanced to 550F.

But, since hose assemblies have metallic end fittings, their reaction to the fluid is as important as the hose.

Compounds of Neoprene and Buna-N resist petroleum base oils and some synthetic fluids. However, Butyl rubber swells so much in these fluids that a hose of it would soon be ruined. Phosphate base fluids like Pydraul, Skydrol, and Cellulube swell Neoprene and Buna-N rubber, but do not affect Butyl. Metal hose can corrode, so you must select an alloy which will resist corrosion adequately for the expected life of the hose.

• **Arctic, desert, sea?**—Hose and fitting material must be selected to withstand their environment. They're affected by humidity, salt air, sand, dust and fungus. Fittings on metal hose are usually the same material or a similar alloy as the hose and braid. For synthetic hose they are anodized aluminum alloys, cadmium or zinc plated mild steel, aluminum, bronze, brass, or stainless steel.

• **How will it move?**—In a hydraulic hose, fatigue life depends on operating pressure, pressure fluctuation, and hose movement. To install hose properly, you have to analyze how it will move. Only bending motion will permit adequate fatigue life. This may be radial where there is a simple bend, or offset which produces a reverse bend. Axial motion (compression or extension) and torque movements should be avoided.

• **How much restriction to flow?**—Before you can accurately figure pump pressure in a system, you must know pressure drop through the lines. In a corrugated hose this is two to three times the drop through smooth wall tubing, depending on convolution pattern. Losses at entrances, exits, bends, and elbows can be figured from data and formulas. Nomographs are helpful to figure synthetic hose size to meet flow and velocity requirements.

• **What's coming in hose?**—One thing is certain about future needs: they'll be much different from today's. Trends in hydraulic systems, particularly for aircraft and missiles, are 6000-psi impulse pressures with temperatures of 800 F in the next several years.

Reliability is becoming more and more important and the temperature advance is causing real problems in guaranteeing performance with synthetic hose ma-

Concluded on page 90

Single unit divides flow equally

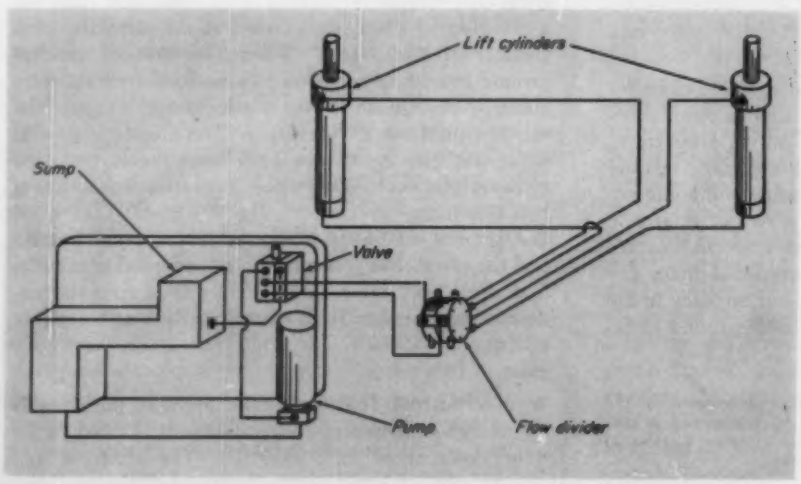
• By M. VAN DUSEN
Powrworker Div., Clark Equipment Co., Battle Creek, Michigan.

LIFTING and carrying large sections of pipe with this pipe handler requires that both hydraulic cylinders move together at the same speed. This calls for equalization of flow to the cylinders from a single source. Normally, two motors would have to be used for the job. We would have to pipe each one for inlet and outlet, and hope that their delivery would be close to equal. Instead, we used a positive displacement flow divider of the gear type, to divide a single stream of fluid into two equal flows to within 3% accuracy.

Rather than having a separate tank, the reservoir is integrated into the structure of the machine. This saves fluid storage space so that the unit is more compact for its factory duties.

The system operates at 1500 psi., with a 13,000-pound lifting capacity. ▼▼▼

CONCRETE PIPE HANDLED in the plant. Up to 72" inner diameter can be handled by the 2-cylinder lifting machine.



SUMP INTEGRAL WITH FRAME is an interesting space saver. Gear type flow divider can displace 0.405 cubic inches per revolution of its shaft for each of its outlet ports.

Nike's underground launching system

• By R. W. KING, *Chief Engineer*
Wayne Industrial Div., Wayne Pump Co., Fort Wayne, Indiana

While watching a service station lift operate, Edward Rosenfeld, a civilian architect-engineer employed by the Corps of Engineers, U.S. Army, conceived the Nike erection system.* This article which describes the final design shows why hydraulics proved simpler, cheaper, and more reliable than various electrically powered designs.

This article was awarded $100 *in the* 1959 APPLIED HYDRAULICS & PNEUMATICS *Prize Paper Contest.*

NIKE missiles are stored in an underground chamber which provides maximum protection to the population with the least amount of surrounding property to be purchased as a safety area. This storage method protects the missiles from enemy strafing and bombing, as well as fallout and ground shock waves of an atomic attack. It also protects them from extreme weather variations so they are ready and operational under any conditions. Maintenance and check-out are easy in the large, air-conditioned, well-lighted underground structure.

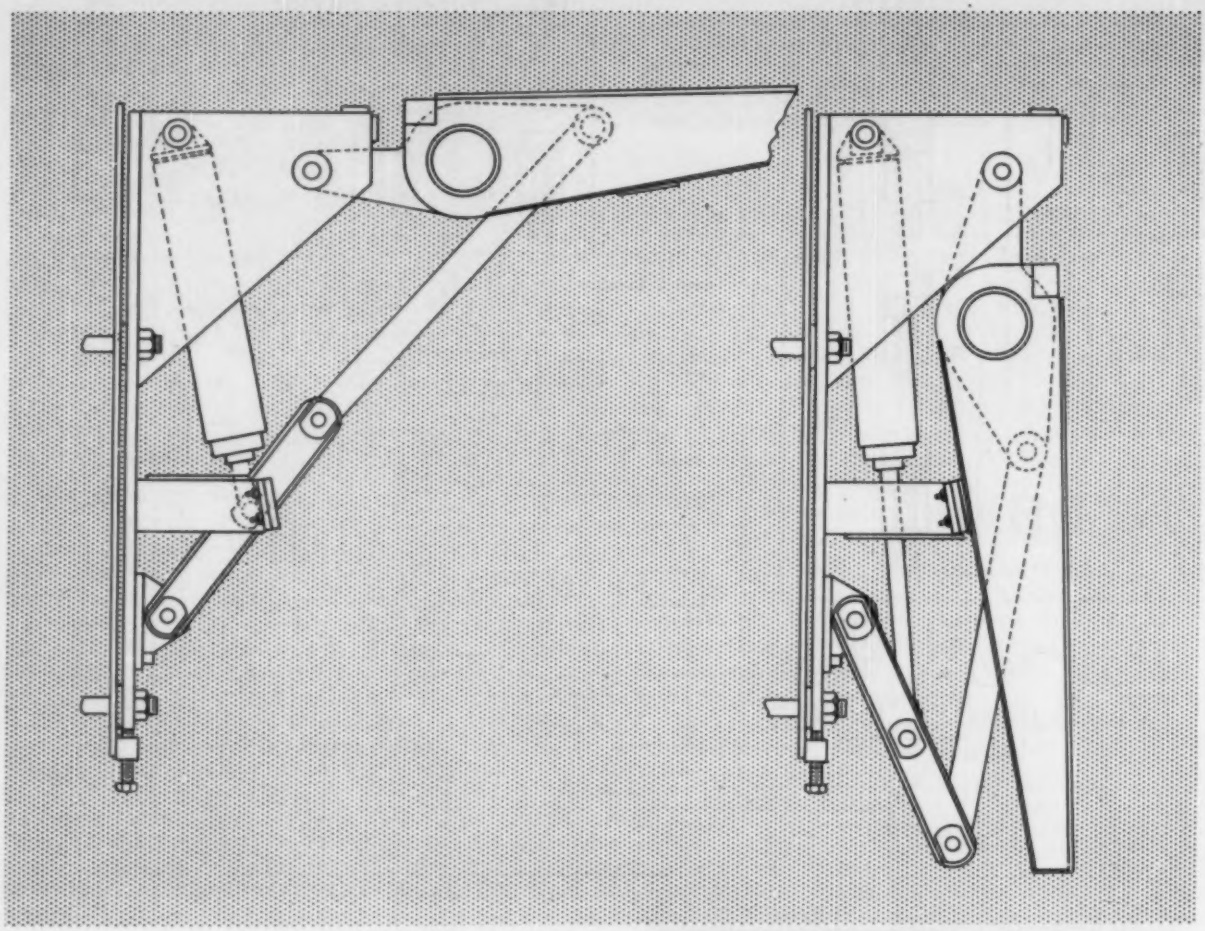
The missiles are attached to launching rails which run on a track to a large hydraulic elevator. The huge hatchway opening is covered by two large steel doors, hydraulically actuated by the same system which powers the elevator. When an air attack warning is received, the two large steel doors open downward like aircraft bomb bay doors.

The elevator with its missile in place automatically rises. The missile is initially horizontal and rides on a launcher which starts to erect at the same time the elevator starts to rise. When the elevator reaches ground level, four cast steel locking bars, hydraulically actuated engage under the platform and support the elevator platform during firing. The missile is now in firing position and can be fired immediately from the elevator platform. The whole operation takes about half a minute.

After the missile is fired, the locking bars retract, and the elevator lowers quickly to load another missile. The steel doors close automatically to protect the underground chamber from blasts of adjacent launching units.

• **Mechanical features**—The elevator platform is about 54 feet long and 10 feet wide. It is rated to lift a net load of about 30,000 lbs. The platform and

**The original design ideas were further developed by the Corps of Engineers, U. S. Army, who later awarded a contract for the production of the hydraulic elevator systems to The Wayne Pump Co., Fort Wayne, Indiana*



DOOR-OPERATING CYLINDERS act through hinge-and-linkage arrangement to move the hatch doors through a 90-degree arc and retract them completely out of the hatchway. The cylinders are rated for 2000 psi and are equipped with hydraulic cushioning in the rod end to decelerate the doors when they are almost fully open. All seals are O-rings except for V-ring rod packing.

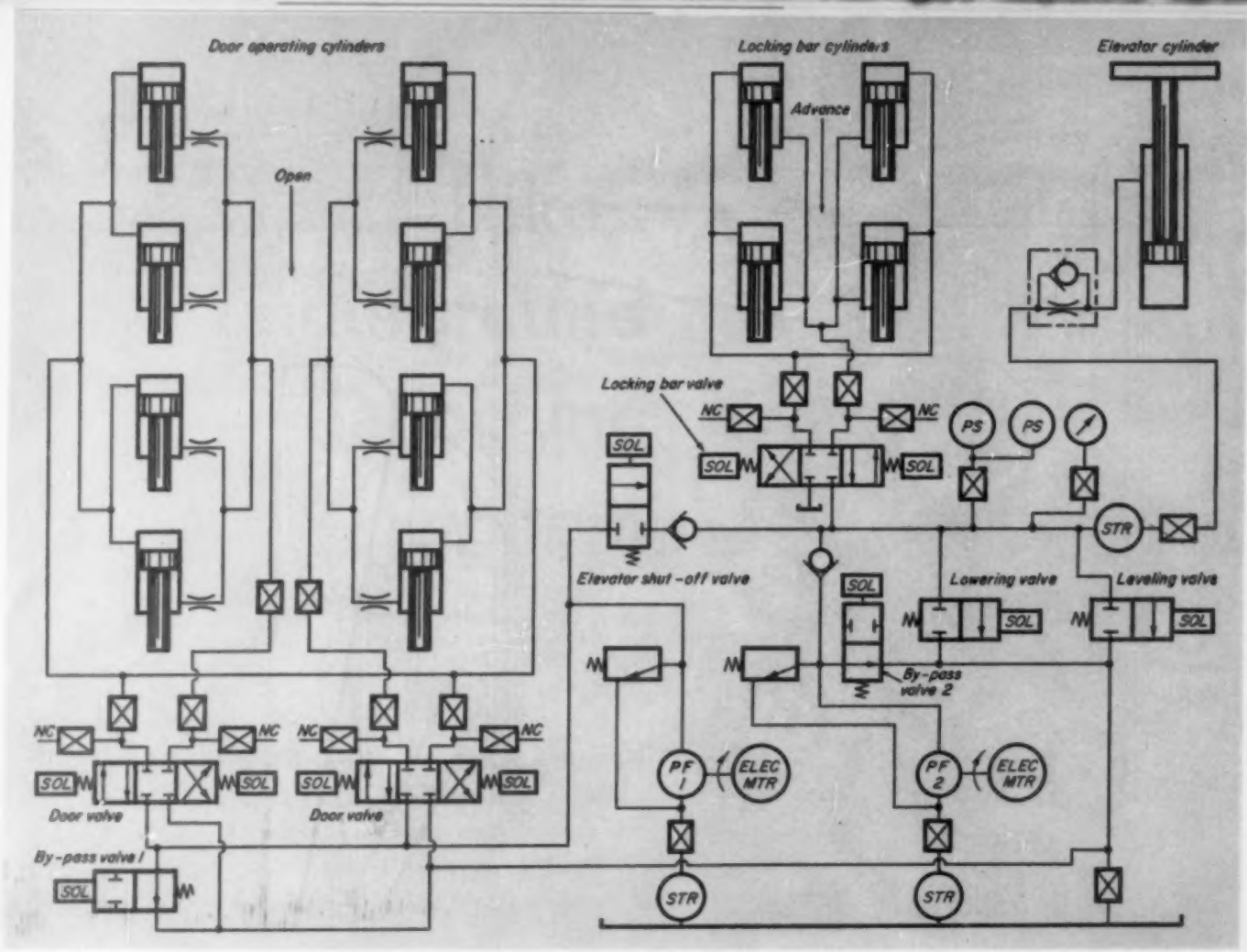
chassis weigh another 30,000 lbs. A single-acting hydraulic cylinder raises this elevator platform. The cylinder plunger is attached under the combined center of gravity of the elevator platform, missile, and launcher. However, this center of gravity shifts as the missile is erected and lowered during elevator operation. A unique cable equalizer system compensates for this unbalance and holds the elevator perfectly level at all times. The cables are attached to the structure and the elevator platform similar to a draftsman's parallel straightedge.

The elevator platform is guided on rails. The guide rail is a heavy T-section with heavy angles welded to each side of the leg of the *T*. Large V-notched rollers engage the angles on the guide rail. This system has minimum rolling friction, has no binding or maintenance problems, and easily takes the large overturning loads to which the elevator is subjected.

• **How the system works**—Referring to the circuit diagram, assume that the doors are closed and the elevator is down. When the signal is received to raise the missile for launching, a switch is actuated and motor 1 starts its pump. Pump output is initially bypassed back to tank, relieving the starting load on the pump and motor. At the same time, a warning bell above ground rings to clear personnel from around the hatchway.

After a brief warning period, by-pass valve 1 is energized and starts to close. At the same time, the door-operating valves are energized, and the spools shift to direct oil flow to the door-operating cylinders which open the doors. When both doors are fully open, the door-operating valves are de-energized, and the elevator shut-off valve is energized. Pump 1 delivery starts raising the elevator. At the same time, the launcher on the elevator starts to erect the missile to a vertical position. After the elevator starts, pump 2 starts. After reaching full speed, its bypass valve closes and the elevator raises at maximum speed.

As the elevator approaches the top of the hatchway pump 2 shuts off, and the elevator decelerates until it reaches a position over the locking bars. At this point, pump 1 shuts off. The locking-bar valve is energized to direct oil flow to engage the locking bars. System pressure created by the weight of the elevator and its



500-PSI HYDRAULIC SYSTEM is powered by two herringbone-gear pumps. Two-way valves bypass pump delivery during start-up to limit pump load and motor starting current.

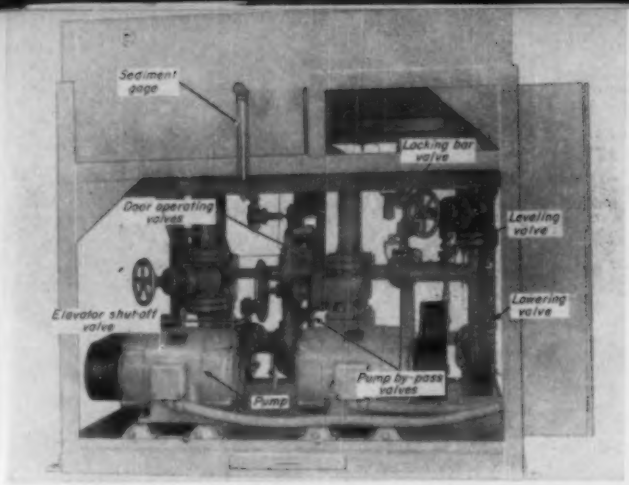
missile load on the plunger then forces oil flow into the locking bar actuating cylinders, and the locking bars engage. When all four locking bars are fully engaged, the leveling valve is energized, and the elevator gently settles about two or three inches onto the locking bars. As the load is relieved from the main cylinder, the system pressure drops and is detected by the pressure switches. One pressure switch shuts down the elevator automatic cycle. The missile is fully erected at about the same time as the elevator is locked in place, and the missile can then be fired.

After the missile is fired, another switch is engaged and the automatic lowering cycle begins. Pump 1 starts, and its bypass valve then closes. The elevator shut-off valve opens, and the locking bar valve is energized to raise the elevator off the locking bars, and to retract the locking bars from under the elevator. When all four locking bars are fully retracted, pump 1 bypass valve is de-energized, bypassing pump 1 delivery to tank. The elevator shut-off valve closes. The lowering and leveling valves are energized at this time and the elevator descends at full speed.

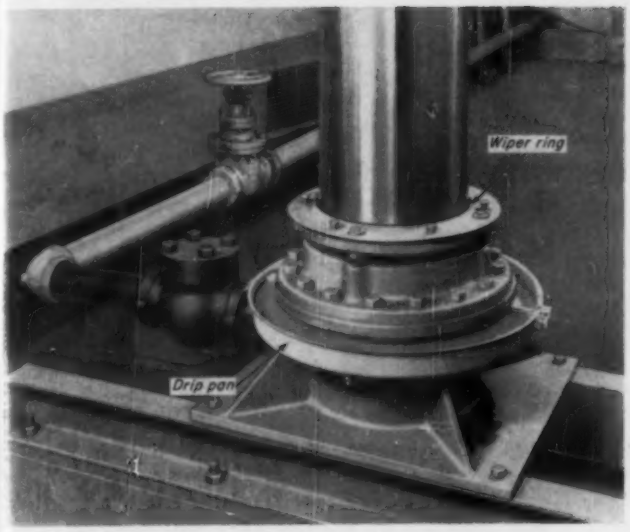
At the same time the elevator starts to descend, the missile launcher on the launching platform starts to lower its launching rail. As the elevator approaches the bottom, the lowering valve gradually closes and the elevator platform decelerates until it rests on its pedestals. The leveling valve is then de-energized by one of the pressure switches. Pump 1 bypass valve and the door-closes solenoids of the door-operating valves are energized. When the doors close, the cycle is complete.

• **Component design**—The main cylinder plunger is 13.75 inches in diameter and has a total stroke of about twenty feet. Although a smaller plunger could have been used with a higher system pressure, this size plunger was required for structural rigidity at full stroke. The plunger is made from a single piece of seamless steel tubing. It is supported in the cylinder by a single, elevator-type, poured babbitt bearing. The seal around the plunger consists of five V-rings made of duck-reinforced synthetic rubber. These rings are split for easy installation. A wiper ring wipes dirt off the plunger as its lowers. This protects the packing. Because of the long stroke, it is necessary to keep some lubricating oil on the plunger. A drip pan is installed around the cylinder to collect oil wipage off the plunger as it lowers.

The pumps are herringbone gear type. They have roller bearings and a mechanical shaft seal, and are



80-HP MOTORS DRIVE PUMPS through multiple V-belts. To save space, motors are intermittently rated in 40-hp frames and insulated with Class B insulation. Motor starters are reduced voltage, auto-transformer type to limit starting currents. Since emergency power is developed by diesel-powered generators, this starting system also limits generator size.



13.75-In. ELEVATOR CYLINDER has a poured babbitt bearing and is sealed with 5, reinforced rubber V-rings. The drip pan collects wipage as the cylinder lowers through its 20-ft. stroke.

rated for 500-psi service. Pump 1 delivers 175 gpm. Its full capacity is used to operate the doors so that no oil has to be inefficiently bypassed during door operation. Pump 2 is rated at 190 gpm.

• **Special valves**—To eliminate severe hydraulic shocks in the system, special, 2-way, pilot-operated valves were developed with independent adjustments to control both opening and closing speeds. The pilot seats and poppets are stainless steel to reduce wear. The solenoids are designed and insulated for continuous duty and protected by waterproof, oil-tight covers. To prevent dirt particles from jamming in the pilot valve or the speed control orifice, filters are installed in the supply line to the pilot valve. These globe type 2-way valves have resilient discs to prevent internal leakage. The disc retaining nut is specially designed to throttle off oil flow gradually as the valve closes. This helps prevent system shocks. The lowering and leveling valves have screw-adjusted piston stops to control flow.

A special 1", 2-way flow control valve was designed to control flow to and from each door-operating cylinder. These permit final speed adjustments to synchronize all eight cylinders and adjust sequencing of the two doors.

Another special 3" flow control valve acts as a safety valve if the lowering valve malfunctions or a line fails. This would cause severe damage by allowing the missile elevator to drop very fast, crashing into the bottom pedestals. The valve is connected just before the main cylinder. It permits free flow for raising and restricted flow for lowering. The flow control orifice is fixed. It is sized so that under the worst malfunction condition, the elevator's maximum descent speed would not harm the missile, or operating personnel.

Because of the large amount of air that the system breathes, there is a water evaporation and accumulation problem in some high humidity areas. A simple system is installed to detect and remove accumulated water.

The power unit has a pressure gage and test connection for servicing. Most of the lines are welded pipe with suitable flange and union connections for servicing piping and components. The reservoir is vented through a special combination oil bath air filter and flame arrestor.

• **Why hydraulics?**—This question has been asked hundreds of times. There are many answers. Several of the most important are: (1) basic simplicity, (2) ease of applying hydraulic actuators to all system functions, (3) inherent reliability of all important components and entire system.

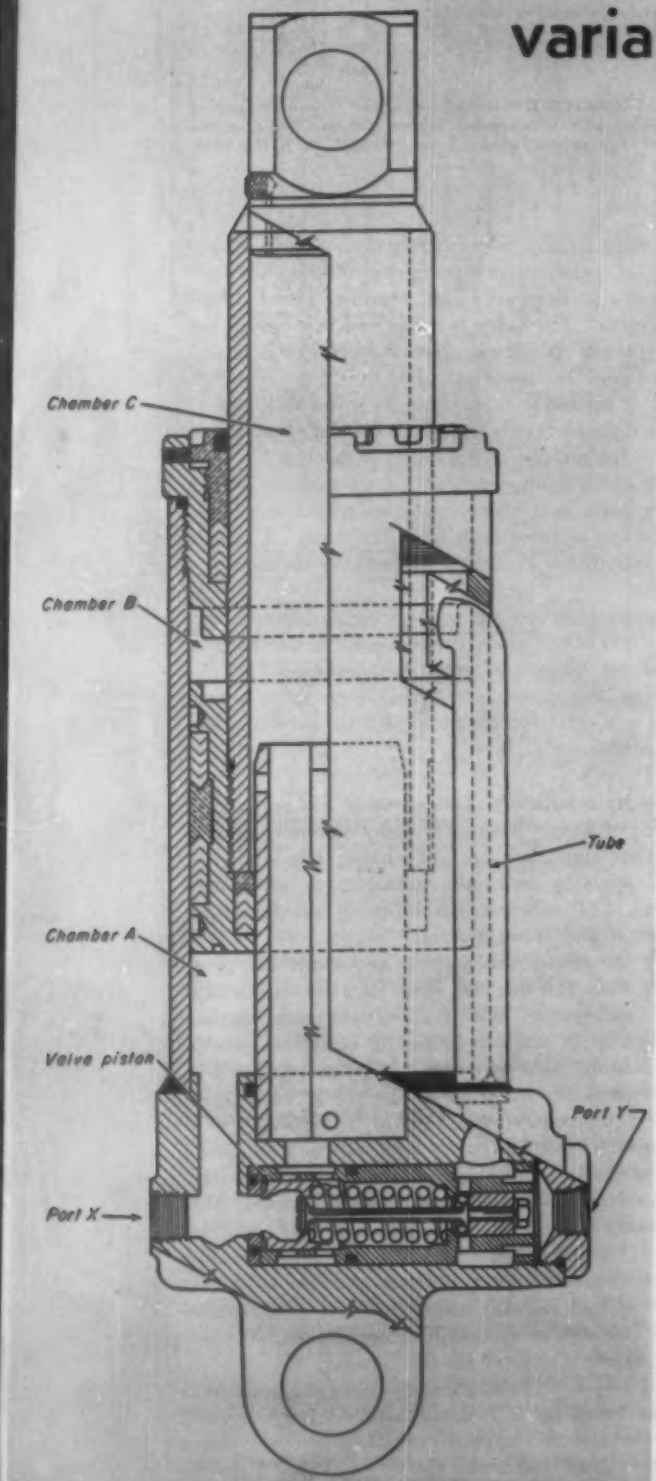
While the system did develop into something more complex than the original idea from an automotive lift, it is still simple. With only a basic understanding of hydraulics, a serviceman should easily follow system operation. This was a very important design factor, because Army personnel had to be trained to maintain the equipment.

Other underground systems with various mechanical and electrical actuators have been tried without success. An early model had spring-actuated locking bars with electric motor retractors. This proved very unreliable. Various schemes were tried to develop cable-and-motor operated doors, but none gave the important features of hydraulically actuated doors. The requirements of the system did not lend itself at all to a cable and electric motor drive for the elevator.

Reliability was one of the most important considerations in selecting a hydraulically operated system. While the system required considerable development and refinement, and many special components had to be developed, the basic components are essentially simple and foolproof. Maintenance can be performed

Concluded on page 90

Rapid approach with variable area cylinder



Courtesy Crown Engineering Corp.

SUPPOSE you need the force of a 6-in. dia. cylinder during part of the stroke, but a 4-in. dia. would handle the rest. If you use a standard cylinder you have to settle for the 6-in. dia. and accept the lower speed for the entire stroke. Here's a cylinder that gives you the force of a 6-in. piston when the load demands it, and the speed of a 4-in. piston when load decreases.

Fluid extending the rod acts on one or both of two piston areas. A built-in, spring-loaded valve directs fluid to one area at low loads and both areas at high loads.

• **Operation**—With the cylinder fully retracted, pressure fluid directed to port *X* enters chamber *A*. As the piston extends, fluid is displaced from chamber *B* through the tube and valve into chamber *C*. Excess fluid returns to the reservoir.

As the load on the cylinder increases, the pressure at port *X* also increases, moving the valve piston to right. This movement opens chamber *C* to system pressure. The effective piston area is then increased by the area of the piston in chamber *C*. Line pressure continues to act on this increased area until the piston rod resistance decreases to the valve set by the valve spring. The valve piston then moves to left and opens chamber *C* to tank.

To retract the cylinder, pressure is applied to port *Y*. The poppet piston in the valve moves up, directing pressure fluid into chamber *B*, but not chamber *C*. The fluid displaced from chamber *C* exhausts through the poppet valve and returns to the reservoir with the fluid from chamber *A*. ▼▼▼

FLUID PRESSURE acts on one or two piston areas to extend the double-acting cylinder. The force resisting movement of the piston rod determines the area of the piston exposed to fluid pressure.

CYLINDER IS TESTED by connecting between two bulldozers.

How COMMERCIAL Fluid Power stacks up more sales for materials handling equipment

COMMERCIAL hydraulic components, pumps, control valves, cylinders, deliver the 22,000 lbs. of lift that help the Taylor Yardster cut handling costs—enabling one operator to outperform 3 to 6 men with a derrick.

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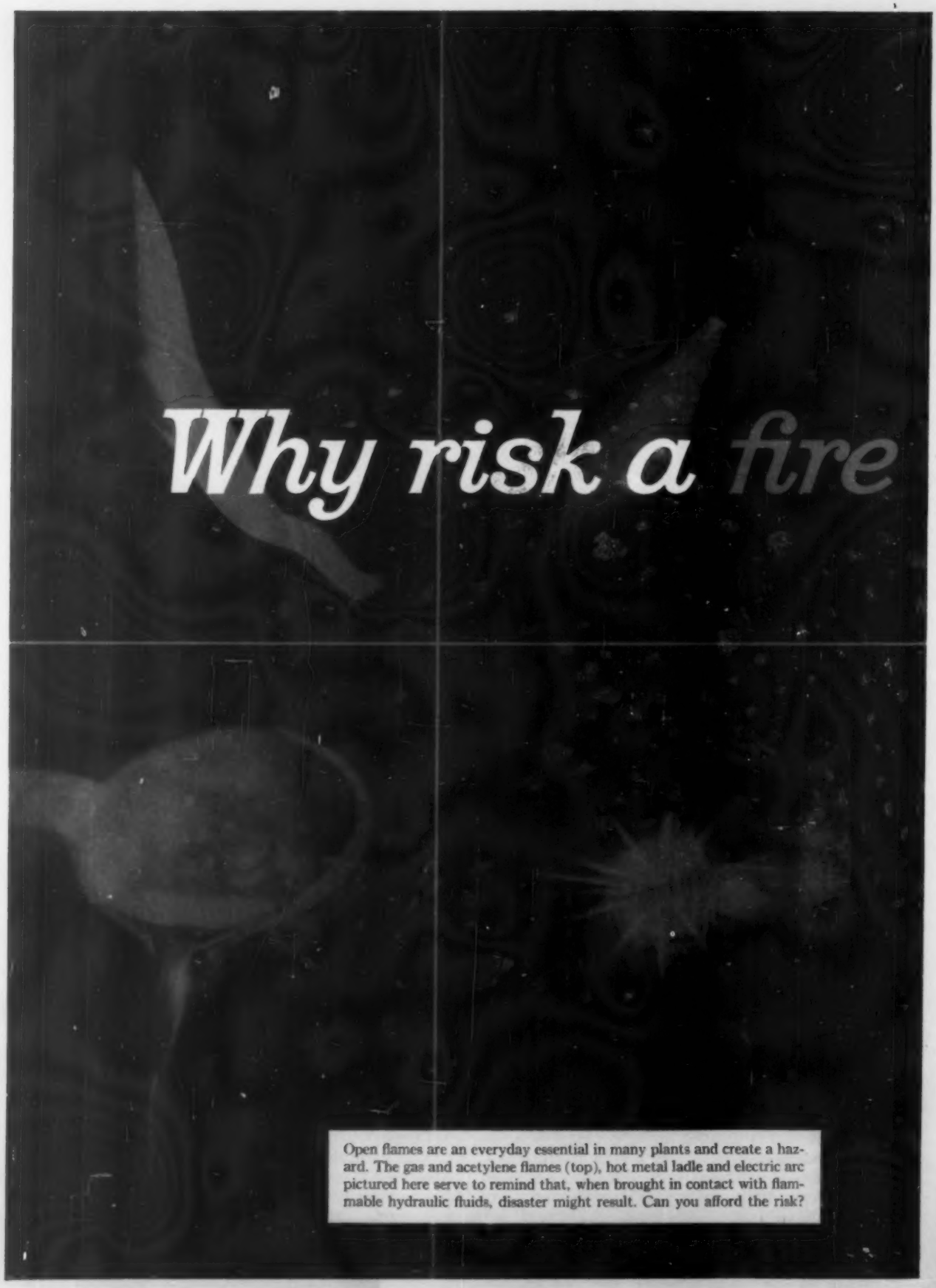

Open flames are an everyday essential in many plants and create a hazard. The gas and acetylene flames (top), hot metal ladle and electric arc pictured here serve to remind that, when brought in contact with flammable hydraulic fluids, disaster might result. Can you afford the risk?

Mobil Research

At left: Test developed by Mobil Research shows how atomized petroleum hydraulic fluid is easily ignited by small gas flame; at right, how when replaced by Mobil Nyvac, no ignition occurs.

disaster? *Insure the safety of your plant and personnel with a Mobil fire-resistant hydraulic fluid!*

Mobil's newly developed family of fire-resistant fluids for hydraulic systems meets every type of industrial requirement . . . provides adequate protection at lowest possible cost.

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These Mobil fluids offer a practical means of safeguarding personnel, property, production schedules . . . increasing your sales profits. Call in your nearest Mobil representative today. He'll be glad to give you full details.

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Mobil Nyvac—combines the fire-quenching qualities of water with glycol and special additives for lubricity and viscosity. Rust inhibitors protect machine parts both above and below fluid levels. Unusual resistance to deposit formation and wear. Impressive viscosity stability, anti-corrosion, and anti-foam properties. Excellent performance at low temperatures.

Mobil Solvac—low-cost, oil-water emulsion fluid particularly suited to systems with plunger and centrifugal-type pumps. For systems serving large presses, forging machines, rubber presses and steel mill back-up roll balances. Resists bacterial growth, has excellent rust-inhibiting properties.

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AVAILABLE WITH A
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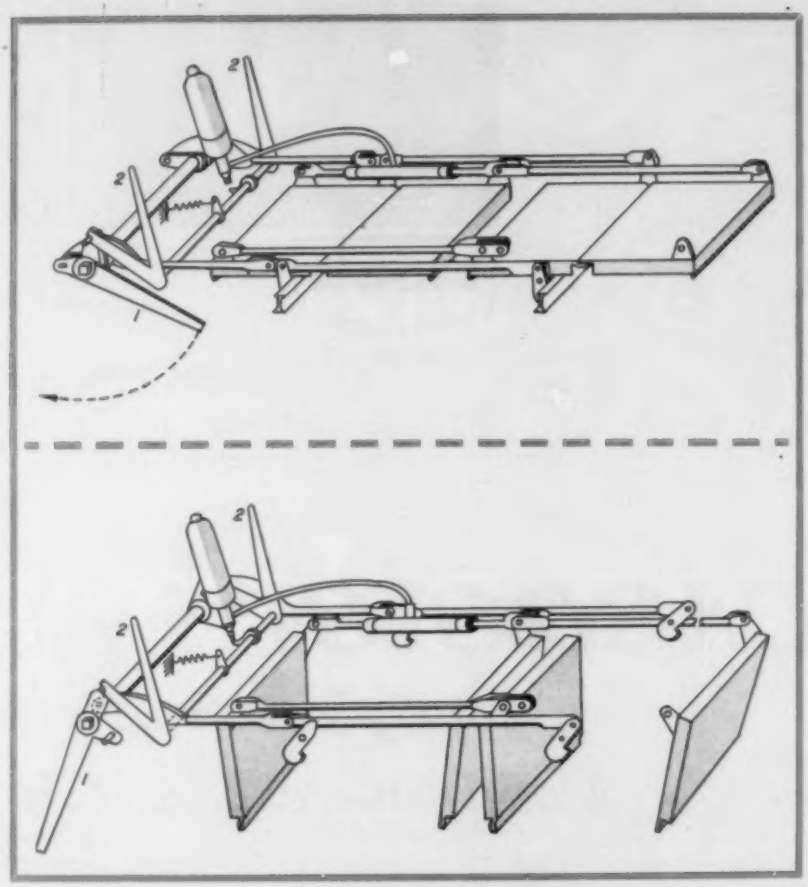


FALLING COAL SUPPLIES THE ENERGY to charge an accumulator which returns it to close the doors. Lever 2 acts as a safety interlock. Pushing lever 1 down releases the latching fingers. Actuating lever 2 clockwise rotates the spring-loaded cam shaft, opening the bypass valve in the accumulator. Lever 2 returns to its original position as a safety latch for lever 1 which is returned by the doors.

Stored energy closes coal car doors

• By **J. H. MERCIER**, *General Manager, Olaer-France, S.A., Bois-Colombes, France*

This article was awarded honorable mention in the 1959 APPLIED HYDRAULICS & PNEUMATICS *Prize Paper Contest.*

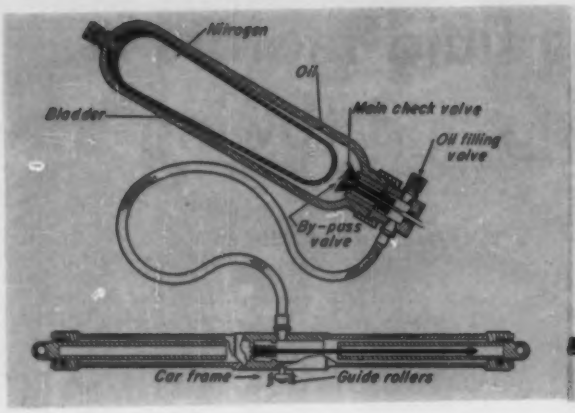
HERE'S an example of how you can use an accumulator to store energy which would be wasted otherwise. A portion of the potential energy, released when coal opens the bottom doors of a railroad coal car, is transferred to the accumulator and later used to close the doors.

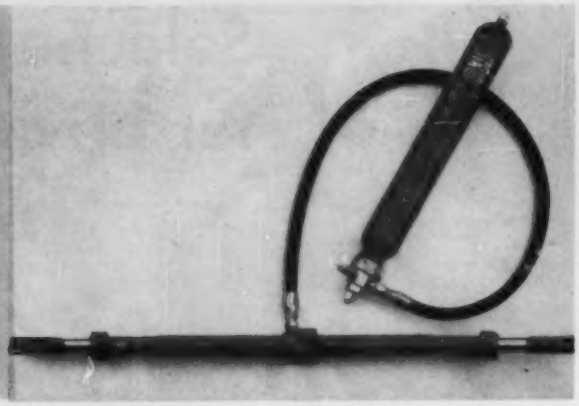
About three seconds are required for the 30 tons of coal to fall out of the hopper car. It takes only 0.2 seconds for the mass of coal to slam the four doors wide open. This causes very high oil flow out of the actuator into the accumulator. This energy is sufficient to close the doors later, since only their weight and hinge friction have to be overcome.

• **Actuator design**—The special 52-inch actuator has two single acting, hollow rams, one extending from each end. When the doors open, these rams act as pumps to force fluid into the accumulator. When accumulator fluid is released at 2350 to 1840 psi, a priority device incorporated in the actuator's center section directs it to extend one ram before the other. This makes one set of doors close first for proper locking. Actuator stroke is 19 in.

V-rings seal the rams against leakage, and rubber scrapers keep dirt out of the hydraulic fluid. Costs were cut by using rough tubing as supplied for the outside cylinder and ground tubing for the rams.

• **Accumulator design**—The bladder type accumulator is especially suited to this high speed application because of its low inertia. The standard anti-ex-





COMPLETE HYDRAULIC SYSTEM is made up of accumulator, actuator, and connecting hose. Valve incorporated in accumulator releases high pressure fluid to close doors. Priority valve in actuator directs fluid first to one ram, then the other, so one set of half doors closes first.

BOTTOM DOORS WHICH RELEASE COAL from this car have advantages over side doors or car-tilting arrangements. Side doors need a center partition to channel the coal, and this increases the dead weight. In addition, an electric shaker is usually required to loosen coal and adds to the power requirements as well as wear on the car. Also, side doors are hard to close. Tilting requires elaborate and expensive stations and loss of time in uncoupling and re-coupling each car.

trusion valve was replaced by a special valve which combines four functions. In addition to preventing accidental extrusion of the synthetic rubber bladder, it also acts as a check valve to prevent accumulator discharge. A mechanically actuated check valve bypasses the main accumulator poppet valve and releases high pressure oil to close the doors. The accumulator valve also incorporates a rupture-disc type safety valve and an oil-filling valve. Accumulator nominal volume is 305 cu. in. Nitrogen precharge pressure is 1400 psi.

A large internal diameter hose (¾ in.) was chosen to permit high flow during compression of the two actuator plungers as the doors swing open. The hose has a double wire mesh for durability and resistance to the abrasive coal dust and is flexible to withstand vibration.

A small portable hydraulic power pack consisting of motor-driven pump, reservoir, and nitrogen bottle operates the doors for maintenance when the car is empty. The doors can also be operated by a simple, hand-operated screw jack dropped between two door hinge extensions. ▼▼▼

What the system has to do

1. Although all four doors open at the same time, the closing mechanism must close two of the half-doors before the other two mating half-doors close.
2. Because of the actuator's high length-to-diameter ratio, it bends slightly. Its seals must not be affected by this bending.
3. Leakage at the piston rods and at the valves must be negligible because the accumulator is the only compensating reservoir.
4. As each door moves through an 85-degree arc, the actuator must move slightly up and down.
5. The system must operate consistently through a wide ambient temperature range and resulting pressure variations.
6. Piston rods and seals must be well protected in the atmosphere of coal dust, grit, falling coal lumps, snow, and rain.
7. Emergency door actuation must permit closing when the car is empty.
8. Maintenance must be simple.

Selecting fluid motors for driving and towing

• By **LESTER L. MYERS**, *Chief Engineer, Mobile Aerial Towers, Inc., Fort Wayne, Indiana*

and **D. J. ARNOLD**, *Denison Engineering Div., American Brake Shoe Co., Columbus, Ohio*

MOBILE PLATFORM must fit through these garage doors when ready for storage. Rubber pads on the outriggers, rubber tired wheels, and drip pans under the hydraulic system permit operation on polished interior floors.

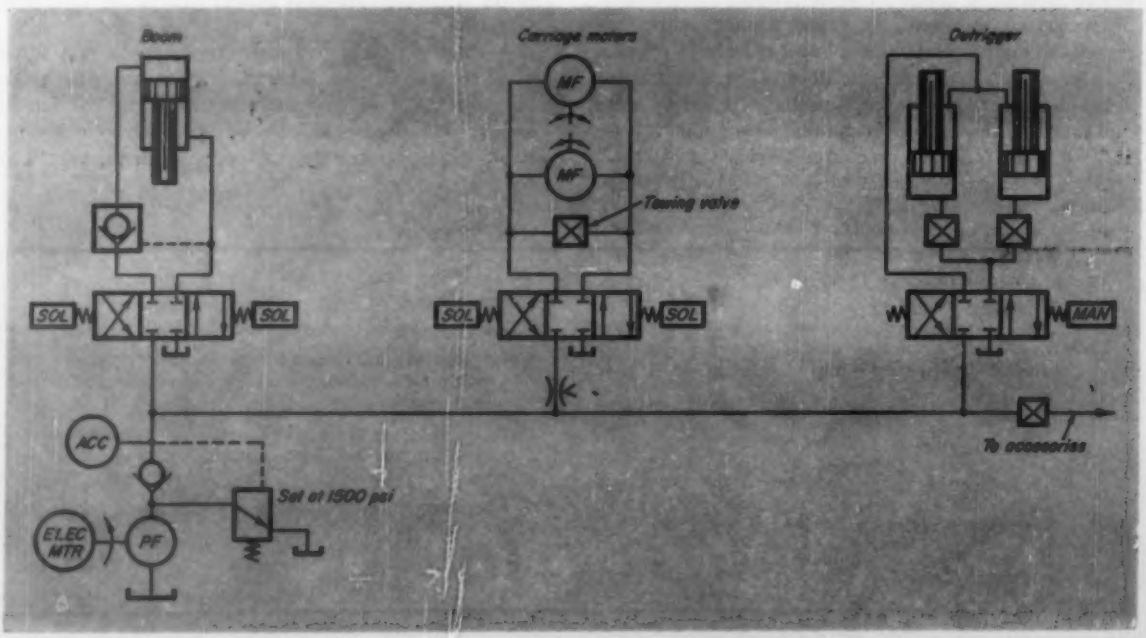
This mobile unit is self-propelled at 2.3 mph. It can be towed at speeds to 15 mph. This is how a fluid motor is sized to propel the trailer, without overspeeding during towing.

IN DESIGNING a fluid motor drive for a vehicle, the reduction ratio between the motor and the driving wheels of the vehicle is usually selected to operate the motor at maximum rated speed. This results in the lowest cost and the highest volumetric efficiency. In this case, however, there was the additional requirement of towing the unit at six times its self-propelled speed. To prevent over-speeding of the motors during towing, a single reduction roller chain drive with an 8:1 ratio is used. Fluid motor speed during towing does not exceed 2000 rpm.

When it is self-propelled, the wheel torque requirement of the vehicle is 4800 inch pounds. With a chain

Continued on page 86

TOWING VALVE BETWEEN MOTOR LINES permits circulating fluid through motors when towing the mobile platform. Accidental bucket drop is prevented by pilot check valve in the boom line.



NEW SOLENOID VALVES *by Airmatic*

These corrosion-proof valves have only one internal moving part and a completely protected solenoid coil. The coil is fully sealed from air, oil, gas and water . . . and will not overheat on continuous duty. Coils for continuous or intermittent duty, a-c or d-c, are interchangeable.

Life expectancy is many millions of cycles and by renewing the one-piece valve plunger, many millions more can be expected. The plunger can be replaced without disturbing rigid piping.

DISTRIBUTORSHIPS FOR THESE NEW VALVES ARE AVAILABLE

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ORIFICES	1/16" THROUGH 3/16"	1/16" AND 3/16"
VOLTAGE	MOST A-C AND D-C	MOST A-C AND D-C
DUTY	CONTINUOUS	CONTINUOUS
POWER CONSUMPTION	10 - 20 WATTS	10 - 20 WATTS
HEAT RISE	WITHIN UL LIMITS	WITHIN UL LIMITS

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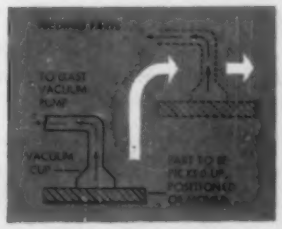
SELECTING FLUID MOTORS

Concluded from page 84

reduction of 8:1, 600 inch-pounds are needed from the motors to drive the wheels. The load is split between two vane-type motors, operating in parallel at 900 psi. A bypass valve is installed between the fluid lines of the motors, so that during the towing period fluid will circulate through the motors. This bypasses the closed center, 4-way valve.

The system has a 30-gallon reservoir supplying a 9-gpm pump which charges an accumulator to the setting on an unloading valve. At 1500 psi, the valve unloads the pump. A three section, 4-way valve, remotely controlled from the elevated bucket, controls movements of the two boom cylinders and the fluid motor which rotates the turntable. A manual 4-way valve controls a pair of outrigger stabilizers. A 4-way solenoid valve in the drive motor circuit is controlled by forward and reverse pushbuttons on the handle of the steering tongue. A solenoid "deadman" valve directs oil to the boom control valves when energized by a foot switch in the operator's bucket. Pilot check valves on the two boom actuating cylinders insure against dropping the booms in case of hose or tube failure. A flow control valve adjusts the vehicle speed. Interlock limit switches prevent raising the boom until the outriggers are lowered. A shut-off needle valve, teed off the main line, may be used to operate such accessories as hydraulically driven saws, and clippers. The operator's bucket contains controls as well as quick couplings for hydraulic tools. ▼▼▼



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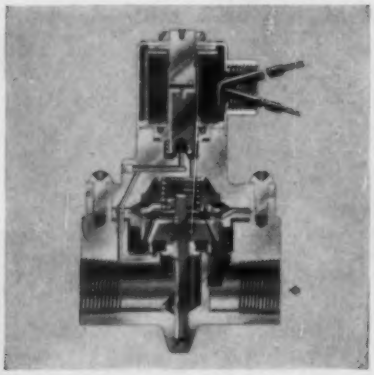
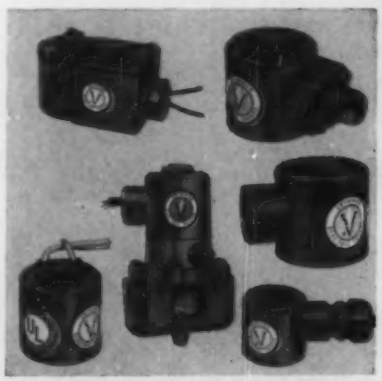
Skinner 2-way Solenoid Valves provide High Flow at Low Cost

Unusually low-cost model... the LC2 valve. A small, light, normally closed valve. Permits full flow through 1/2" orifice with 3/8" or 1/2" NPT ports. Will control all common media: air, oil, water, etc. Handles pressures from 5 psi to 150 psi, with temperature ranges from minus 40°F to plus 180°F, and will operate on all popular AC and DC voltages.



Features of L Series valves. Like all Skinner valves, these are built to UL standards. Their bodies are made of forged naval brass and their internal parts are stainless steel and brass. Soft, synthetic inserts and seals provide bubbletight operation. And a unique, Buna-N coated nylon diaphragm assembly assures long life. They mount in any position directly to the line. A variety of coils for common AC and DC voltages is available.

Full extent of line includes L2 models featuring 1/2" orifice with 3/8" or 1/2" NPT ports, 3/4" and 1" orifices with 3/4" and 1" NPT ports. At greatly reduced cost, these valves permit applications not possible before. They are available normally open or normally closed in standard or explosion-proof construction.



Custom installation can be had with these options. There is a large selection of electrical housings that can be rotated 360° for easy connecting. Also available for these L2 valves is manual override that permits opening or closing of the valve in the event of a current failure.

For quickest service, write for Skinner's Nationwide Stock List. It covers all of the valves universally stocked by Skinner distributors and includes a number of the L Series valves. From this list, your local Skinner distributor can quickly meet your requirements.

A complete line. There's a Skinner solenoid valve for almost any flow application with a wide variety of media: air, oil, water, inert gases, hydraulic fluids, kerosene and gasoline. Orifice sizes range from 3/64" to 1". Pressure ratings range from vacuum to 3000 psi. Explosion-proof models are UL approved for Class 1, Group D and Class 2, Groups F and G.

Skinner solenoid valves are distributed nationally.

For complete information, contact a Skinner Representative listed in the Yellow Pages or write us at Dept. 31D.

SKINNER ELECTRIC VALVES

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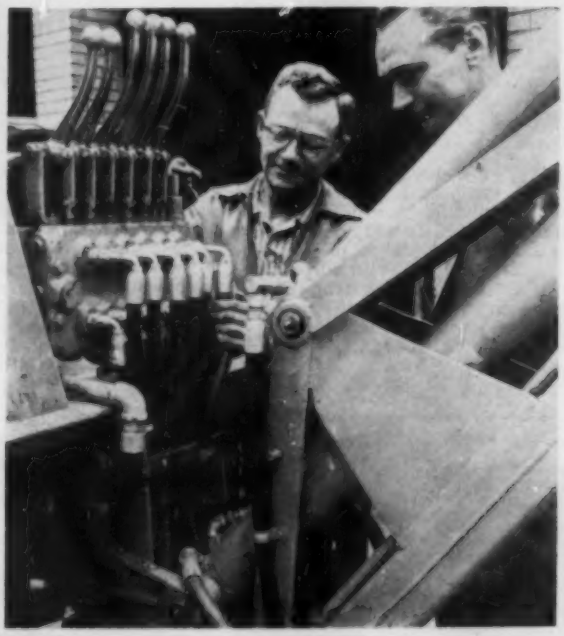
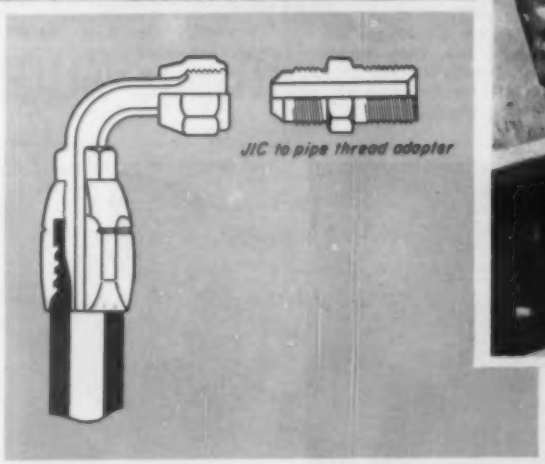
THE SKINNER ELECTRIC VALVE DIVISION • NEW BRITAIN, CONNECTICUT

We're not afraid of valve maintenance anymore

• By **ROBERT COX** and **JOSEPH BRIGGS**, *Industrial Service Engineering, Aeroquip Corp., Jackson, Mich.*

How long would it take you to remove a valve like this? How hard would it be out on a job?





EVEN the most critical buyers of mobile equipment may not notice how hydraulic components are connected, until they have to make fast repairs. Just one experience in unscrewing pipe connections with a wrench, breaking off a few fittings in the port, removing twice as many connections as necessary to get enough swing makes a user a lot more conscious of how hydraulic lines are connected.

Maintenance men of the water and sewer department of Oak Park (Chicago suburb) found that out when they had to change a 6-spool valve on their back-hoe. Because the valve had pipe thread ports, they had to remove adjacent lines to get wrench clearance for the lines in the center. When they finally got the replacement valve re-piped, two of the connections leaked. Repairs tied up the machine for two weeks.

Resolving never to let this happen again, they investigated modifying the valve for straight-thread connections. The result is shown above. Twelve hoses are now connected to the valve in two rows of six each. By using elbow fittings (longer ones for the top, shorter ones for the bottom) they got rid of hose crossovers.

A pipe-thread/JIC adapter permits removing the lines at the JIC connection. The adapter is sealed as a permanent part of the valve. If the hose has to be replaced, the elbow and integral female swivel can be reused with the new hose. The straight-thread connection seals perfectly, yet disconnects easily since it does not depend on friction thread fits. Unlike pipe, the fitting does not have to be turned to install or remove it. ▼▼▼

VANE PUMP POWER

for

CATERPILLAR products

2000 PSI...BY DENISON

2000 PSI HYDRAULIC PUMP

... is incorporated into power systems of dozens of types of earthmoving equipment by leading manufacturers. Denison 2000 psi hydraulic power gets jobs done faster with dependable trouble-free operation for toughest workloads.

Here's the quick, smooth action of Caterpillar's No. 955 Traxcavator with exclusive new "side dump bucket". Built to operate at *full capacity* 'round-the-clock, this Cat-built excavator-loader is another of many construction units factory-equipped with advanced Denison hydraulic equipment.

The new side dump bucket – powered by a single Denison 2000 psi vane pump–allows "in-line" loading... reduces that job to a straight forward-backward operation, *cutting operating cost significantly.*

The compact Denison *vane pump* delivers continuous, trouble-free hydraulic power for *faster load-and-dump cycles*... plus powerful *breakout action* and plenty of reserve "go" for toughest workloads.

The key is *continuous,* high volumetric efficiency in Denison pumps. Result: no drop-off in work speed... no sluggish operation to slow up the job.

Plus these advantages—"cartridge" construction means speedy in-field servicing. All-weather starting feature prevents pump damage. And Denison pumps guarantee less weight, less cost-per-horsepower... more payload-per-dollar in your earthmoving equipment.

Your Denison Hydraulic Specialist can tell you more about improving equipment performance with *hydraulic power to 5000 psi.* Call him in now to discuss *making your equipment more profitable to the man who buys it!*

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American Brake Shoe Co.
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DESIGNERS ENGINEERS...

Write for your copy of Bulletin P-9-1-A on Denison "TD" Series Vane Pumps. Includes complete specifications and operating data.

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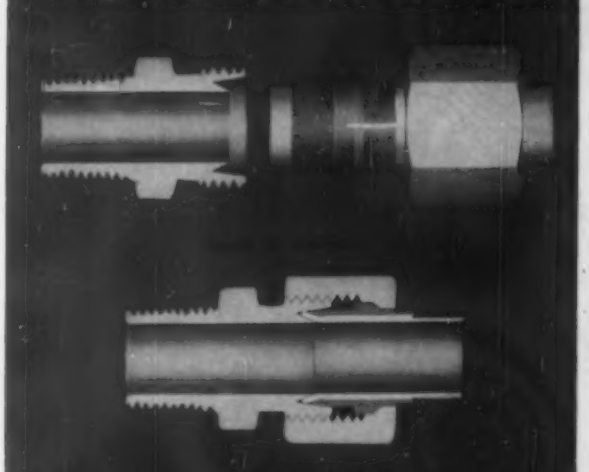

FLODAR
Self-Flare Tube Fittings

The Efficiency Of A Flare Fitting—Can be used on thin wall tubing—provides a seal on the ID of the tube.

The Easy Installation Of A No-Flare Fitting—no time consuming flaring operation—no flaring tools required. Can be used with heavy-wall tubing and, provides a seal on the OD of the tube.

- Easy Assembly—Simply insert tube into fitting and tighten nut. "Rock Bottom" stop signals that joint is sealed.
- Double Seal—seals on both outside and inside of the tube.
- Lower Cost—FLODAR'S Self-Flare fittings cost less to buy and install.

Tube shearing and work hardening are eliminated . . . FLODAR Self-Flaring fittings can be reassembled time after time without fear of leakage or damage to tube and fitting.

Priced competitively, this fitting is available in tube size from ⅛" to 2" and in steel, stainless, brass and aluminum.

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- Flare & No-Flare-Type Fittings
- High Pressure Pipe Fittings
- Straight Thread Tube Fittings
- Metal-to-Metal Porthole Fittings
- "O"-ring Type Porthole Fittings

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NIKE'S UNDERGROUND LAUNCHING SYSTEM

Concluded from page 77

with minimum mechanical, hydraulic, and electrical training and experience. Most malfunctions which can occur will not completely disable the system. Certain practical schemes have been developed for hand operation in case of prolonged power failure.

• **System versatility**—This was demonstrated as the Nike missiles grew larger and heavier. Due to foresight of the original designers, the elevator platform has been large enough to accommodate the latest Nike Hercules missile. With some structural changes to the chassis, and minor modifications to the pumps and valves, hydraulic pressure of the system was raised from 300 psi to 500 psi to lift the heavier missiles.

Another example of system versatility is that units are in operation in areas of the world where the temperature is as cold as —50 F. Other units are installed in tropic regions. Few modifications were necessary for these requirements. ▼▼▼

SELECTING FLEXIBLE HOSE

Concluded from page 72

terials. Metal hose, to date a theoretical hopeful, is now a practical solution, thanks to a technological break-through.

Corrugated metal hose, of the multiple ply variety is used, but with some basic changes. Otherwise, this too would succumb to the damaging shock waves set up under repeated impact pressures in present day, high performance, hydraulic circuitry.

The answer is in a corrugated tube wall of a new configuration designed to absorb and dissipate harmful stresses. A 3-ply wall structure combining different metals is used. Each ply performs a specific role. The outer and inner plies are selected for structural strength and corrosion resistance, stainless steel being an example. The center ply is a material of low elastic modulus, one possessing high damping characteristics, such as copper, aluminum, or magnesium. This sandwiched-in material absorbs the vibrations which the harder and more highly elastic material of the inner and outer plies can not. Vibrational stresses do not build up to harmful intensities with this combination of materials.

Sizes to 1¼" ID have been made experimentally, and sizes through 2" are planned. Conventional envelope dimensions will be held. Proof of the advance is in test results under Air Force Specification MIL-H-8788, but with temperatures raised to 550 F. Here, 150,000 to 200,000 cycles of 0 to 4500-psi shocks are being handled by the new hose. Development is continuing with other metal combinations for even higher performance levels.

The adaptability of this new product is not limited to hydraulic use, but for pneumatic service as well. In fact, it should aid the designer wherever vibrational stresses, whether flow induced or externally induced, are a problem in flexible connectors. ▼▼▼

Circle 116 ➔

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dependable U.S. motors *prevent shutdowns!*

...it pays to specify

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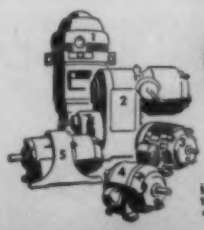
Because production shutdowns *cost far more than motors,* real economy lies in buying motors of *quality* you can depend on! U.S. UNICLOSED is the motor choice for normal production needs. U.S. UNICLOSED MOTORS give you the quality and dependability that are built into every U.S. motor—plus protection *far* superior to ordinary dripproof motors. Only U.S. protects all windings with nature's non-organic, non-carbonizing insulation—asbestos! This prevents costly burn-outs. Unlike ordinary makes, U.S. motors have shock-resistant, corrosion-resistant cast iron frames that are *normalized*—heat-seasoned to prevent warp! To protect bearings, U.S. LUBRIFLUSH transverse lubrication purges old grease. This minimizes lubrication and maintenance requirements. These and many other factors add up to U.S. *quality*—the kind you can depend upon to keep production lines running! U.S. UNICLOSED 3-phase AC motors are available in RATINGS ¼ to 250 H.P. It pays to specify: "U.S. MOTORS."



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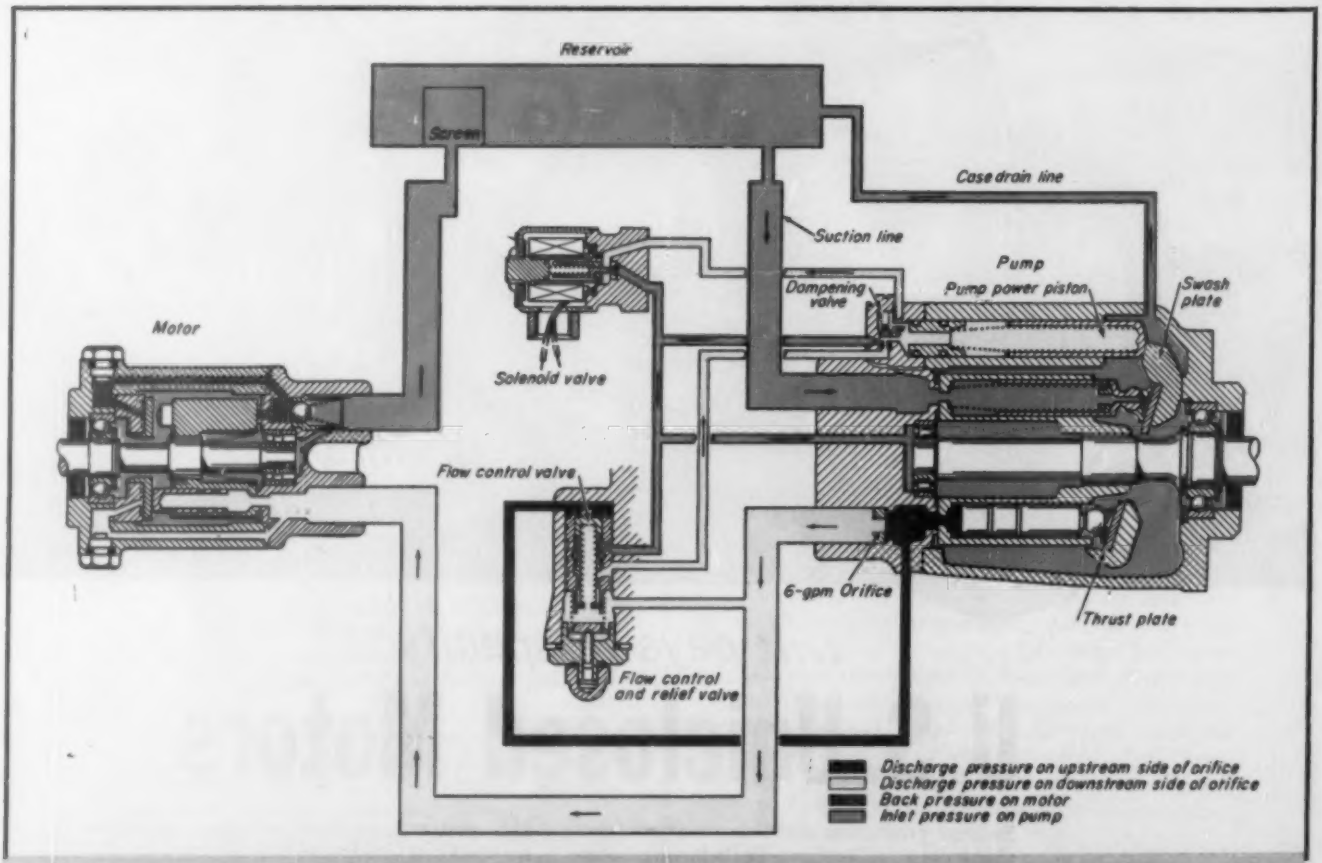
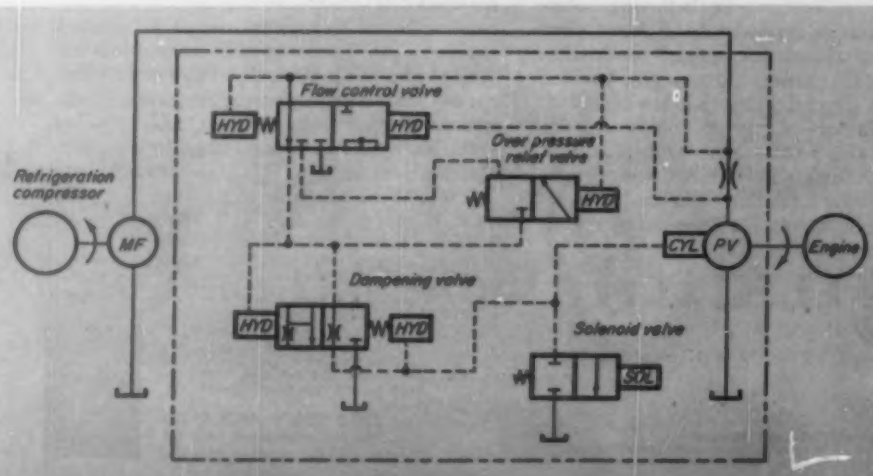
Flow control valve positions pump

• By R. J. MURPHY, *Application Engineer,*

This truck refrigeration unit, driven by the vehicle's engine, is kept at constant speed regardless of engine speed or load on the system. An engine-driven, variable displacement pump regulates flow to a constant displacement fluid motor.

CONSTANT displacement fluid motors require constant oil flow if they're to run at constant speed. The variable displacement pump runs at a fixed ratio to engine speed (450-3000 rpm). It continually measures its own output and adjusts itself to provide a constant flow to the constant displacement motor, driving it at a constant speed even with changes in engine speed or changes in load on the motor.



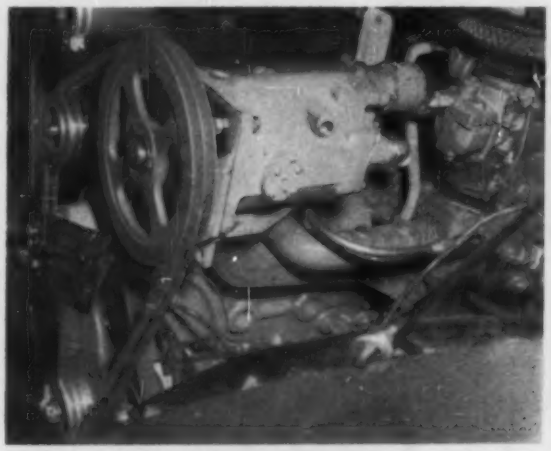


FLOW CONTROL VALVE is the heart of this refrigeration drive system. A 6-gpm flow is assured by the flow control spool sensing pressure drop across the orifice. In turn, this regulates forces acting on the pump swash plate.

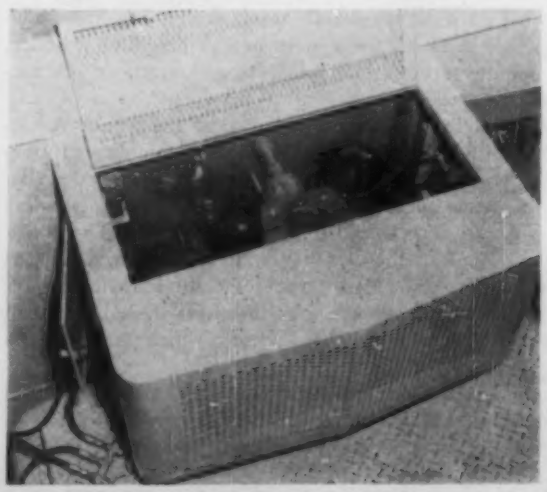
to keep constant speed

Sundstrand Hydraulic Division, Rockford, Illinois

With the truck engine idling and the refrigeration on, the 450-rpm input speed results in 6 gpm delivery. As engine speed increases and flow tends to rise, pressure rise on the upstream side of the 6-gpm orifice overcomes the spring loading on the flow control valve spool. This closes the fluid supply line to the power piston chamber of the variable displacement pump, and opens the chamber to tank. The opposing force on the pump's axial pistons then moves the swash plate to decrease delivery, thus compensating for the increased input speed. If engine speed decreases, pressure on the upstream side of the orifice approaches the pressure on the downstream side, with a corresponding change of pressures on the flow control spool. As the spool is moved by its spring, the power piston is pressurized to overcome the axial piston force. This swash plate movement increases pump delivery to make up for the decrease in input speed.



VARIABLE DISPLACEMENT PUMP mounted in a truck. Engine-driven from 450 to 3000 rpm, this is the only unit of the refrigeration system that must be located in the engine compartment.



REFRIGERATION UNIT with constant displacement hydraulic motor and reservoir are located in this cabinet on top of the truck's cab. Hoses connect to the engine-mounted pump.

This interplay between the forces of the power piston chamber and the axial pistons acting on the swash plate are kept in balance by the flow control valve to provide a constant 6-gpm flow of oil to the fluid motor at various engine speeds, loads, or both.

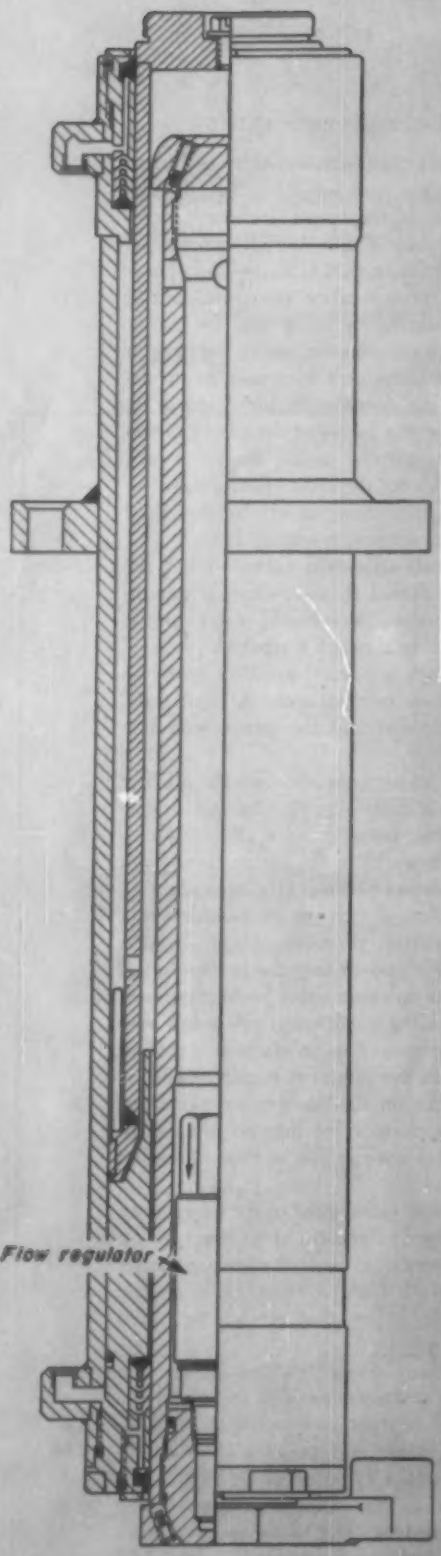
• **Thermostat controls solenoid valve**—When the refrigeration unit has chilled to the desired temperature, a thermostat energizes a solenoid valve in the pump, unloading the pump through a separate passage. The pump then goes into a neutral position until the thermostat calls for more refrigeration. At that time, the solenoid is de-energized and the pressure builds up again.

A small dampening valve near the entrance to the power piston provides a delayed action in putting the pump into stroke. This gives a controlled, smooth start. When the pump is working, the spring force positions the valve to connect an orifice to the power piston chamber. When the solenoid valve is energized to unload the pump, differential pressure compresses the spring, shifting the valve and closing the orifice to the power piston. When the solenoid valve is de-energized, leakage past the dampening valve spool offers the only passage to the power piston. This in effect is a second orifice used only to put the pump in stroke smoothly. Meanwhile, spring force on the dampening valve has been moving the dampening valve into position when the regular orifice takes over in the normal operation of the pump.

Within the flow control valve spool of the pump is an overpressure relief valve in the form of an inner piston in the flow control spool. In case of excess pressure build-up, the pump swash plate is returned to neutral until the pressure falls below that set on the relief valve spring.

• **Motor construction**—Since the pistons are not spring loaded, a back pressure valve in the form of a ball check is provided in the motor outlet to keep the pistons on the swash plate and prevent chatter.

The pump is hydrostatically balanced by hollow pistons transmitting oil to the slipper heads bearing against the thrust plate face. The motor is hydrostatically balanced by pressurizing the thrust plate. ▼▼▼



COMPACT CYLINDER DESIGN combines two single-acting rams in one housing. Lower ram, acting on 1:1 ratio, has about one-half the area of the upper ram acting on a 1:2 ratio, so pressure remains constant throughout the lift. Internal flow control valve is a safety feature to prevent dropping the load.

Cylinder design gives high lift

COMBINING two single-acting cylinders in the same housing has given Yale & Towne a compact fork truck design for high lifts. This design gives 50% more lift for a given overall height of cylinder, so the truck can operate through low doorways and overhead obstructions, yet still do high stacking.

The normal, single-acting cylinder used on most lift trucks is limited in lifting height. To get a higher lift, it requires complicated reeving and higher pressures. The first two lift stages of Yale's new design are similar to conventional action with a single-acting cylinder: 2:1 lifting ratio with the same cylinder size and pressure. The down-acting ram has about one-half the area of the up-acting ram and operates on a 1:1 ratio. Pressure remains the same throughout the lift, the first two stages taking precedence over the third stage because of the heavier weight of the mast members accomplishing the first two stages of lift.

A flow regulator is designed into the cylinder to prevent sudden drop of the load in case a line breaks. Lines are provided at both ends of the cylinder to drain any small leakage around the cylinder packing.

An additional advantage of this design is to lower the center of gravity of the truck mast, making the truck safer, particularly at higher speeds without a load. ▼▼▼

With Extras . . . At No Extra Cost

1. METAL PISTON ROD SCRAPER—protects rod packing, cylinder bore and rod surface by removing all foreign particles.
2. NEW "SUPER" CUSHION for air or METALLIC SELF-ALIGNING MASTER CUSHION for oil.
3. HARD CHROME PLATED CYLINDER BORES AND PISTON RODS for greater protection and reduced wear.
4. ONE PIECE PISTON assures better alignment, longer bearing and packing life.
5. FORGED SOLID STEEL HEADS throughout entire line.
6. PILOTED PACKING GLAND with extra long bearing for additional strength and support to piston rod.
7. NO TIE-RODS TO STRETCH—gives you 360° port rotation . . . less space used . . . full strength.
8. STREAMLINED DESIGN . . . operating pressures to 200 PSI, air; 1,000 PSI oil, non-shock.

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You too—can reduce replacement expenditures—lower maintenance costs with the T-J Spacemaker cylinder line. Designed and engineered for ruggedness, and accuracy of operation, the Spacemaker assures longer, uninterrupted operation.

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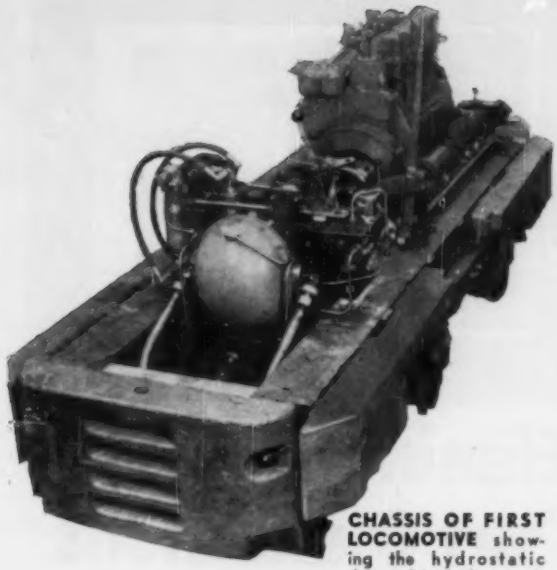
Hydrostatic transmission for yard locomotives

• By **ERIC H. BOWERS,** *Director & Chief Engineer, Dowty Hydraulic Units Ltd., Ashchurch, England*



CHASSIS OF FIRST LOCOMOTIVE showing the hydrostatic drive driven by a 4-cylinder diesel motor.

RAILROAD yard locomotives need high starting torque and continuous maximum power without change of gear ratio or engine speed, to provide acceleration over a wide speed range.

Hydrostatic transmissions provide this performance in either direction of travel. A single lever controls acceleration, braking, and gives a smooth reversal of direction.

We use a simple circuit employing a variable displacement transmission pump, which is fully reversible and directly driven from the diesel motor; and a fixed displacement hydraulic motor which can be driven in either direction of rotation by the transmission pump, and is connected to the rail wheels by reduction gearing.

A secondary low pressure gear pump provides fluid at 75 psi to operate the displacement-changing servo on the transmission pump. This secondary pump also pressurizes whichever is the return line of the main circuit to 75 psi, thus eliminating initially entrained air and preventing the subsequent ingress of air. As the pressure and return lines change over with a reversal of travel direction, a shuttle valve and nonreturn valves insure that the fluid from the secondary pump is fed to the appropriate line.

Heat exchangers for the hydraulic circuit are not

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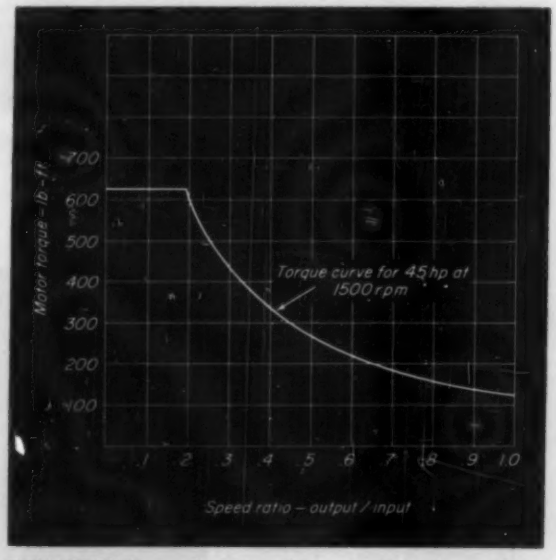
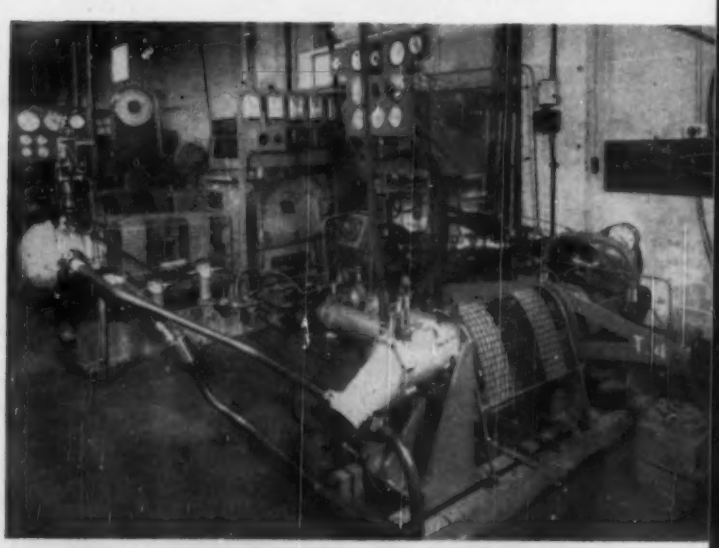
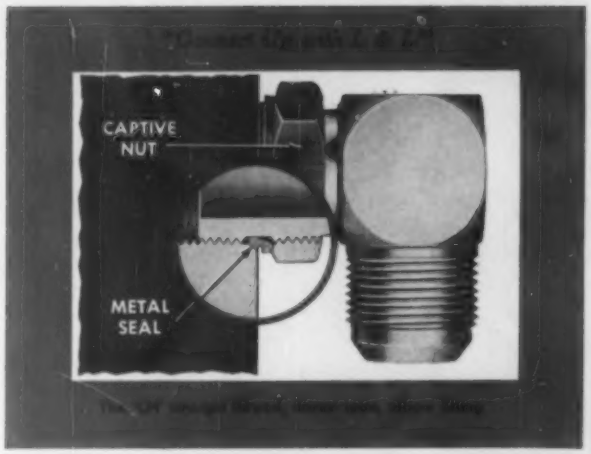


TEST RESULTS are charted on this curve. Note that maximum torque remains constant up to an output/input speed ratio of 0.2:1 in both directions of rotation. Beyond this point, torque varies inversely with speed at constant horsepower.



TEST RIG FOR HYDROSTATIC DRIVE. The complete transmission can be endurance tested and calibrated under full range of operating conditions. Any chosen cycle can be continuously reproduced.



Eliminate Leaky Port Connections with 'CN'® Fittings

Whether using the old pipe-threads or the "new" SAE O-ring straight thread design, hydraulic tube fittings are prone to leak at the port connection. That's a fact.

In contrast, the 'CN' fitting by L & L is **leak-proof**—and it has these advantages: **Repeated re-usability**—the metal-to-metal seal may be undone and remade indefinitely. **No weak link**—the limited-life O-ring is eliminated. **No restricted use**—any fluid, of any temperature, permissable with the metal in the fitting is okay with the metal seal. **Vibration-proof**—the metal seal provides lock-washer action. **Easily directioned**—point angle fittings anywhere, only the captive nut is turned to affect seal.

At no greater cost — standardize on trouble-free 'CN' hydraulic tube fittings—as inevitable as progress itself, the coming industry standard.

L and L Manufacturing Company
21590 Hoover Road • Warren, Michigan

Circle **73** on Time-Saver Card

HYDROSTATIC TRANSMISSION

Concluded from page 97

normally necessary, but under tropical conditions, a small heat exchanger can be fitted to the low pressure secondary circuit.

The transmission pump is a 10-cylinder, tilting-head unit in which the rotating cylinder block containing the axial pistons can be tilted 35° in either direction. All the rotating details of the transmission pump and hydraulic motor, which is fixed at 35 degrees, are identical.

Performance—At the rated speed of 2000 rpm, the transmission pump's maximum delivery is 108 gpm. In normal operation, full pressure (4000 psi) is applied to the hydraulic motor in a stationary condition to produce full starting torque. This torque is maintained up to a hydraulic motor speed of about 400 rpm. Above this speed the torque and pressure fall at constant power (60 hp) as the output speed increases to the maximum of 2000 rpm. Reduction of transmission pump displacement causes the roles of the transmission pump and hydraulic motor to be reversed, and braking is provided by feeding power back to the diesel motor.

Starting of the diesel engine presents no problems, because the transmission pump is set to zero displacement when the locomotive is stationary. A manually operated by-pass valve is fitted to prevent creep, if zero stroke has not been accurately selected. ▼▼▼

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Pneu-Trol Valves combine in a short, compact body, a tapered fine thread needle for extremely accurate air or oil flow control and a floating retro ball check, which permits full flow in the opposite direction. Retro ball floats in most sensitive position to seat, requiring only a slight differential pressure to fully open or close it. Check Valve and Needle Valve incorporate single function features of Flow Control Valve. All valves available in S female pipe sizes — ⅛" to ¾". Valve bodies are made from brass, aluminum, steel or stainless steel. Attractive Prices — Immediate Delivery.

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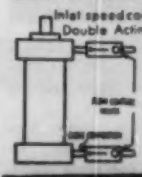
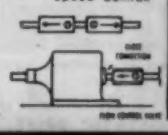

Inlet speed control for Double Acting Cylinder.


Single Acting Cylinder Speed Control.

AUTO PONENTS INC. 2919 GRANT STREET BELLWOOD (Chicago Suburb) ILLINOIS

Circle **19** on Time-Saver Card

Circle **16** →

Arrow AIRLINE SPRAY MIST LUBRICATORS

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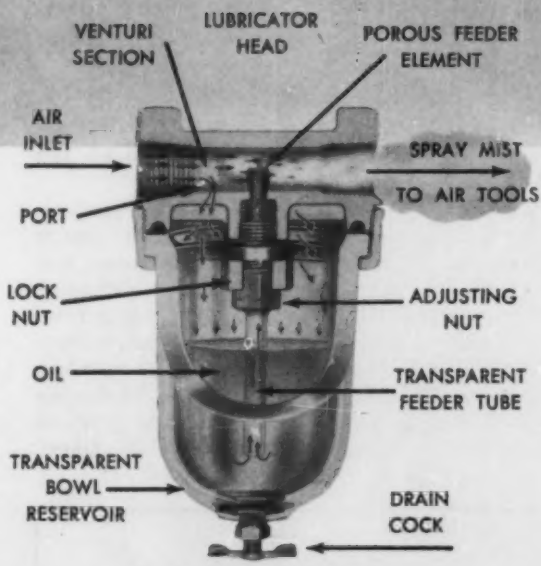

Illustrates the operation of the ARROW "patented" two-stage, tamper- proof Lubricator.

Compressed air from the drop line enters the Lubricator to Venturi section of the Lubricator Head where the porous feeder element protrudes into the Air Stream.

Small ports in front of the porous feeder permits air pressure transfer on the oil surface in the bowl reservoir. The pressure differential created by the Venturi forces the oil to rise in the transparent feeder tube, into and through the porous feeder element which PRE-DIVIDES the Lubricant in this first stage, into minute particles of oil.

The Lubricant now finely divided and saturating the porous feeder element, is now easily and most efficiently atomized from the feeder element, at this second stage, by the action of the Venturi on the compressed air passing through the Lubricator Head.

The two-stage method incorporated in the ARROW LUBRICATOR insures a fine spray mist for wider ranges of AIR FLOWS at lower pressure drops.

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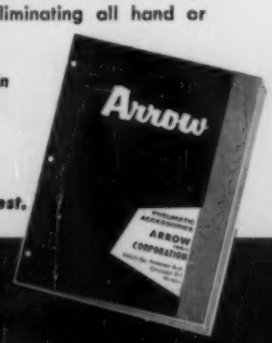


ARROW TOOLS, INC. 1934 S. KOSTNER AVE. CHICAGO 23, ILL.

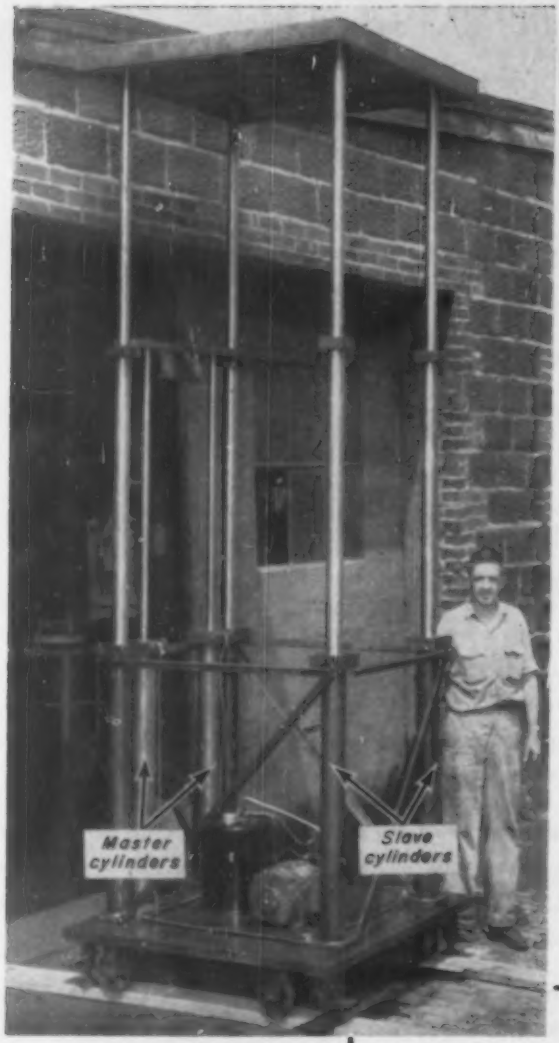
Master-slave system

• By JAY M. ROTH, *Manager.*

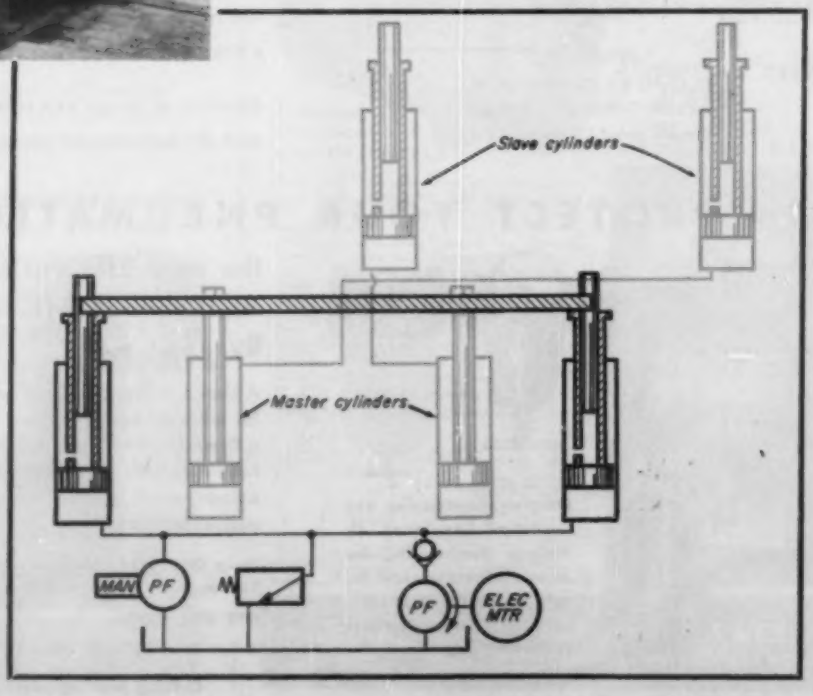
A common way of synchronizing cylinders is to connect them in series. Properly sized, and with good leakage control this method is successful when four cylinders must lift a table or platen. Here's a variation of that basic method for use with single-acting telescoping cylinders.

LIFT a 1500-lb boring fixture from 4′ 8″ to 12′. Keep it level while raising. Hold it at the top for 20 minutes without drifting down. Provide for fast travel as well as fine positioning.

To meet these requirements in a 4′ square platform lift, we decided to use telescoping cylinders—one at each corner. To synchronize them, and insure that the platform remains level, two of the telescoping cylinders are driven by fluid from the pump, and two master cylinders, which are pulled up by the platform, deliver fluid to the remaining two telescoping cylinders. Because each master cylinder drives a telescoping cylinder which is diagonally opposite, the platform remains level regardless of how the load is distributed.



TELESCOPING CYLINDERS at each corner of this platform raise it to 12′ and leave the top unobstructed. Master cylinders which are shown at the left in the photo are pulled up by the corner cylinders at left. The master cylinders supply fluid to the remaining telescoping cylinders in this adaption of a series circuit.



synchronizes telescoping cylinders

Mechanisms Co., Uhrichsville, Ohio

• **Cylinders designed for constant speed**—To avoid the increasing speed characteristic of telescoping cylinders (because of decreasing piston area) the two-stage cylinders were designed so that both sections extend together. Each telescoping cylinder has an outer cylinder, a middle tube, and an inner rod. Oil supplied beneath the piston raises it, forcing oil above the piston to pass through a hole near the bottom of the middle tube. This oil raises the inner rod. The rod area is equal to annular area above the piston, so that for 1″ extension of the piston, the rod extends 1″ with respect to the middle tube and 2″ with respect to the outer cylinder.

Accuracy was very important in machining these areas, and we found that a .005″ error in the cylinder bore would cause nearly 1″ error in the 12′ rise. The easiest way to maintain accuracy was to measure the cylinder ID and the middle tube OD, then make the inner rod to the exact dimensions, so that its area equaled the annular area.

Each master cylinder has an annular area above the piston equal to the piston area of the telescoping cylinders. Therefore flow into the telescoping cylinders, whether from the pump or from the master cylinders, is the same.

Although the diagonal arrangement of master and slave cylinders insures that the platform rises level, since the cylinders are installed at the corners, the table must be built rigid enough to prevent deflecting.

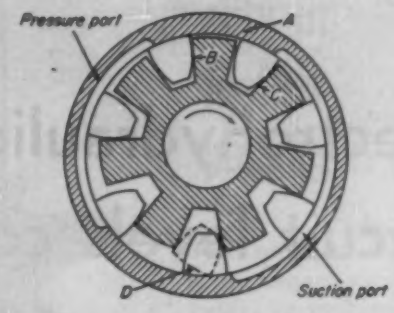
• **New pump supplies system**—For fast travel, the platform is powered by a recently designed pump which replaces conventional vanes by "slippers". (see box). Fine adjustment of the platform height is made by a hand pump.

A relief valve is installed in the system to prevent overloading the platform. Pressure can rise only as high as the relief valve setting, so that cylinder force and platform capacity is limited. A manually operated needle valve permits lowering the platform by gravity.

The platform was to be designed with a safety factor of 4. The 2″ piston rods extending through 88″ have a radius of gyration of ½″, so that L/r is 88÷½ =176. The inner tube is larger than the rod, so it is safe to use the rod in these calculations.

With this slenderness ratio of 176, Euler's formula for column action applies. The condition is that one end is fixed and the other end is free. The coefficient recommended for this is .25. However our own tests on similar installations showed that a coefficient of .36 is actually obtained. Using this coefficient and Euler's column formula, we obtained the buckling load for one cylinder as 10,800 lb. Since there are four cylinders and we wanted a safety factor of 4, 10,800 lb is the maximum allowable working load on the platform. This is much higher than required for a 300-lb platform with a 1500-lb load, but we wanted the platform to resist a reasonable amount of side load even when extended the full 12′. The allowable side loading with a safety factor of 4 is about 800 lb total for all four cylinders.

The boring fixture which this platform supports must be carefully positioned before it is tack welded in place. This may take up to 20 minutes, and the hydraulic system must hold the platform at a fixed height during this period. Performance like that means getting every bit of air out of the system, and this seemed nearly impossible during the development. At first the platform drifted down .012″ during the first minute. After continuous bleeding, we reduced the drift to less than .001″ in five minutes, and this was acceptable. O-rings which seal the cylinders helped greatly in meeting this requirement. ▼▼▼



Slippers replace vanes in this pump design. The slippers can tilt in the rotor slots, so that their outer faces which fit the cam ring give area contact instead of line contact as in vane pumps. Clearance between the slipper and the slot can be as high as .006″. The dotted slipper at position *D* shows that the slippers cannot turn over or wedge in the rotor slot. Sealing occurs at points *B* and *C* as centrifugal force and pressure hold the slippers out and forward against the rotor. In position *D*, pressure holds the slipper against the rotor, and the angle of the driving force, as well as the pressure assures hydrodynamic lubrication.

An electrohydraulic servo system on this combine keeps the separator level while the blades follow the slope of the ground. It remains level on slopes up to 37%.

Electrohydraulic circuit levels combine

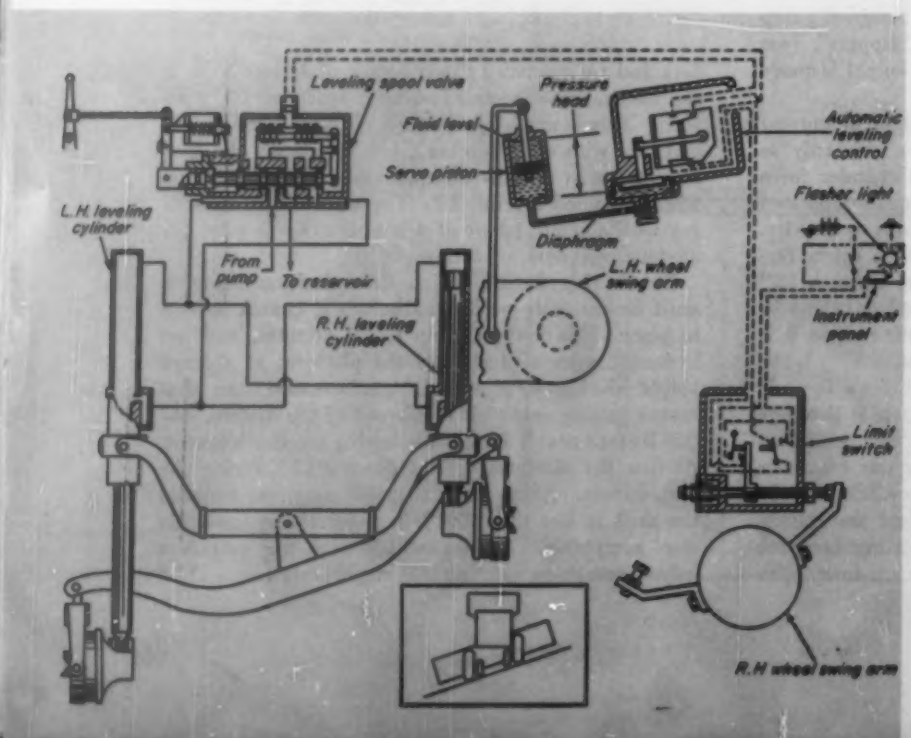
ORDINARILY it takes two men to operate a combine: one to drive it, and the other to level the separator by hand. Here's an automatic leveler on a John Deere combine that lets one man handle the entire harvesting operation. A fluid level sensor combined with an electrohydraulic circuit does the leveling.

The leveling mechanism consists of a fluid container in which the static pressure of a liquid column is held against a low-friction rolling diaphragm. As the column tips, static pressure changes and moves the diaphragm. A linkage attached to the diaphragm actuates snap switches to energize the coils of a spring-centered, 4-way, solenoid valve.

A servo piston in the fluid chamber connects through a push rod to the left wheel of the combine. As the separator levels, the piston displaces enough fluid to move the diaphragm to its neutral position where both switches in the solenoid valve circuit open. The valve centers and locks the leveling cylinders.

The leveling control uses a rolling type diaphragm because the pressure head available to move it is only 4.4 inches of water. This deep convolution diaphragm has low hysteresis and good repetitive accuracy. ▼▼▼

Data for this article was furnished by Bellofram Corp., Burlington, Mass.



THE AUTOMATIC LEVELING CONTROL mounts on the combine so that it is always parallel to the grade. As the combine tilts, the static head of fluid on the diaphragm increases or decreases, moving the diaphragm up or down.

When the combine is at either extreme level position, a limit switch, actuated by the right wheel swing arm, opens the circuit to the solenoid valve. An indicator light tells the operator when he reaches the maximum limit of leveling.

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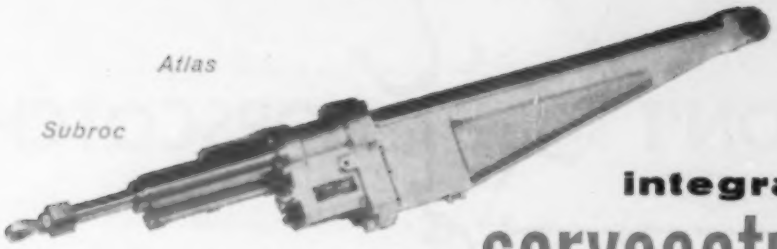

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DECEMBER 1959

AVIATION SECTION

FLUID CONTAMINATION AND HOT GAS SERVOS ORBIT SAE AIRCRAFT MEETINGS 106

Meeting recently in St. Louis, leading aircraft and missile fluid power engineers discussed system and component design. This report gives an account of the current thinking on modular components, system contamination, future hot gas servo design and reliability.

AVIATION NEWS FROM THE FLUID POWER FIELD 112

AVIATION COMPONENT DATA 114

New design approach to hot fluid test equipment demonstrates some hydraulic and pneumatic systems for aircraft and missiles. For more information fill in and mail post card bound in this issue.

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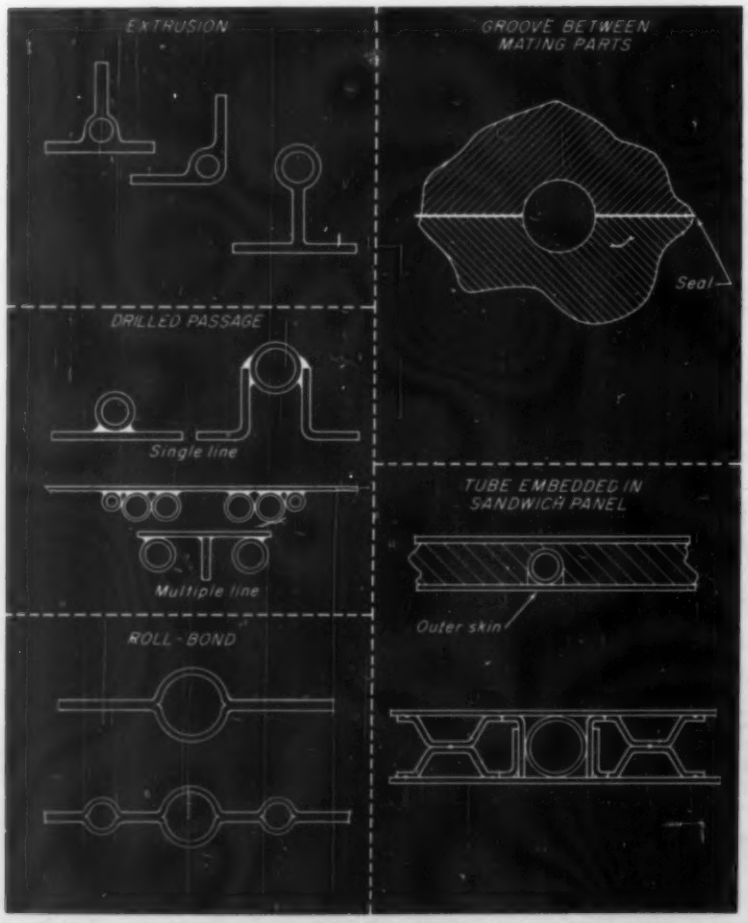
Fluid contamination and hot gas servos orbit SAE aircraft meetings

HIGH performance aircraft and missiles mean high temperature fluid power systems. Because of this, hot gas servos have received new emphasis. Hydraulic system contamination has also been under study. Newest developments in aerospace fluid power were discussed by engineers of industry and government at the week-long session of the SAE's A-6 committee in St. Louis, Sept. 28. B. R. Teree, Republic Manufacturing Co., presided.

• **Project Hydratoy**—This is the intriguing name of a 3-part design study by Chance Vought Aircraft, with Navy BuAer. Chance Vought's J. H. Ballantoni described screw-in type modular components that simplify maintenance and are lighter and smaller than conventional valves.



FLUID-CARRYING STRUCTURAL MEMBERS being studied by Chance Vought for Project Hydratoy. This is an effort to simplify and lighten hydraulic systems for missiles.

Fluid-carrying structural members are another part of this study. Several fabricating methods were presented, including hollow extruded shapes, tubes joined to sheet metal, and semi-circular grooves between mating parts.

Several new, all-metal seal designs were evaluated, as part of

J. H. Ballantoni

. . . modular components will save weight and space

the Navy reliability program to eliminate elastomeric materials.

• **Contamination vs reliability**—In peacetime, missiles are weapons in waiting. Years may pass before they have to be fired. At that moment, they must be as reliable as the day they were delivered. Long-time storage is a cause of contamination which makes servo valves stick and causes other malfunctions. System storage and contamination were discussed in an attempt to pinpoint exact causes of contamination and ways to limit it during long storage. L. Purpura of North American's Autonetics Division and E. C. Rea and N. N. Fruchtow, both of Space Technology Laboratories, said in a paper that most storage contami-

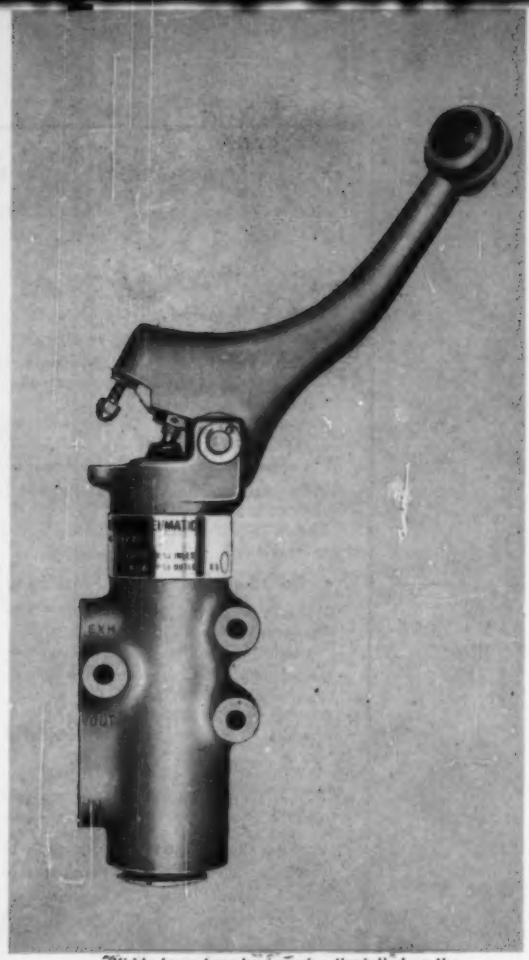
Continued on page 108

Circle 72

Kidde foot-operated brake valve (Installed on the F-27)

Kidde lever dual brake valve (Installed on F-27, de Havilland Caribou, and Howard Ventura)

Kidde handwheel-operated brake valve (Installed on Convair 880 and 600)



Kidde lever-type brake valve (Installed on the F8U, F8U-3, and Aero Commander)

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In operation, pneumatic brake systems draw air from either a 3000 psi fiberglass or steel "bottle". This air supply can also be used to operate emergency landing gear systems or other devices on the aircraft.

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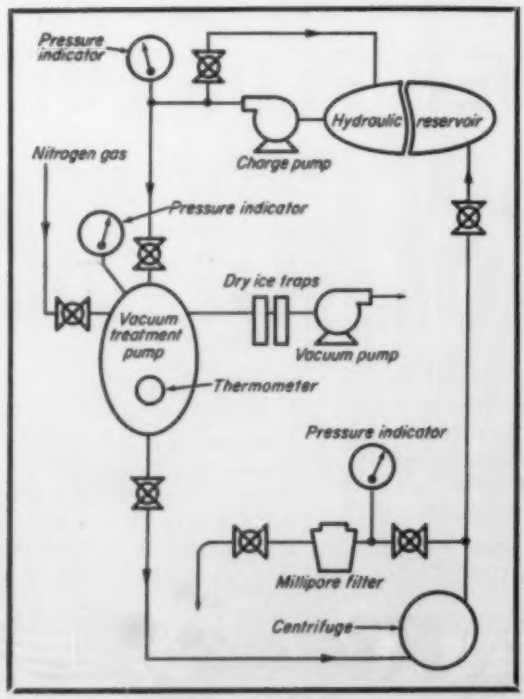
SPACE VEHICLE FLUID POWER APPLICATIONS*

Application	*Type of System*	*Reasons for Choice*
GENERAL		
shock and vibration isolation	pneumatic	inherent response
ballast (cg) control	hydraulic	liquid ballast
door actuation	electrical	simplicity, weight
reactor control	pneumatic or special hydraulic	response and environment tolerances
tracking or orienting mechanisms	electrical or hydraulic	simplicity or response
grappling devices and manipulators	electrical or hydraulic	simplicity or response
unlocking	pneumatic (explosive)	simplicity
TRAJECTORY AND ATTITUDE		
gimballed engines	hydraulic or pneumatic	weight
jetavators	hydraulic or pneumatic	weight
reaction control nozzle positioning	hydraulic or pneumatic	weight and response
aerodynamic surfaces	hydraulic or pneumatic	weight, response, and environment tolerance
inertial reaction flywheel	electrical or hydraulic	ease of control and ability to recover energy
RE-ENTRY OR LANDING		
configuration change	hydraulic or electrical	simplicity
flaps	hydraulic or pneumatic	environment tolerance
speed brakes	pneumatic	environment tolerance
gear extension	pneumatic (explosive)	simplicity
ejection (crew or equipment)	pneumatic (explosive)	simplicity
wheel brakes and steering	hydraulic	response and weight

**From "Design Studies of Fluid Power Systems for Space Vehicles" by C. H. Cannon, Lockheed Aircraft Corp.*



FLUID RECLAMATION PROCESS developed by Hughes Aircraft. The process shows correlation between alcohol-water concentration and centrifuging of solid particles.

SAE REPORT

nation was due to deterioration of elastomeric seals and corrosion of metal parts. They believe that at present we can store missiles for two to three years.

A method for reclaiming contaminated MIL-0-8515 and other high temperature fluids was discussed in a paper by H. Yoshimoto, G. R. Neff and S. Wiener of Hughes Aircraft. Fluid is pumped through a 10-micron filter into a tank where it is held for a few hours at 125 F at a pressure of less than 1 mm of mercury. Gases are distilled and condensed in dry ice traps at —110F. Fluid is then returned to atmospheric pressure and centrifuged at 7200 rpm. The result is reduced contamination without appreciable change in fluid viscosity.

Even with the best fluid production sanitary measures, storage and handling in the field contaminates a hydraulic system.

One suggestion was—that inasmuch as contamination is so hard to prevent, perhaps servovalves should be designed to work with contaminated fluids.

Missile system reliability was discussed in an effort to pin down the causes of failure. Sources listed were personnel errors, poor quality control and outmoded component design. Improvements in these areas will reduce missile failures.

Can contamination be standardized? Frank Moncher of Vickers Inc., submitted a proposed SAE Aeronautical Recommended Practice. It specified the degree and material of contamination for controlled contamination tests. In the discussion that followed, some people questioned the desirability of exact percentages of road dust and magnetic materials in testing. They also questioned the ability of a test system to hold foreign particles suspended in given proportions for any length of time.

• **Hot gas systems**—Component parts of hot gas systems were defined in a proposed specification. A panel headed by Boeing's E. T.

Continued on page 110

Circle 118

GD700 SERIES GAS-O-DOME REGULATORS

Models in bronze or stainless steel
Pilot operated type
Max. inlet: 3600 to 7000 psig.
Outlet range: 10-150 to 400-7000 psig.
Flows to 250 scfm.
Low torque: 35 inch-lb. at 7000 psig.
Panel mounting
Bulletins R12 and R18.

BPR SERIES BACK PRESSURE REGULATORS

Models in bronze or stainless steel
Adjustable relief ranges: From 25-500 psig. to 2000-10,000 psig.
Panel mounting
Bulletin R19

LR SERIES LOADER REGULATORS

Models in bronze or stainless steel
Max. inlet: 7000 to 10,000 psig.
Outlet range: 5-200 to 200-10,000 psig.
Flow: 10 scfm.
Low torque: 35 inch-lb. at 7,000 psig.
60 inch-lb. at 10,000 psig.
Panel mounting
Bulletins R11 and R17

GD90, GD100A AND GD200A SERIES GAS-O-DOME REGULATORS

Models in bronze or stainless steel
Compensated, high-flow type
Max. inlet and outlet: 6000 psig.
Flows to 80,000 scfm.
Remote control and/or panel mounting provisions
Bulletin R18

LV-10 LOADER VALVE

Made in bronze only.
Inlet and outlet: 7000 psig.
Flow: 10 scfm.
Fast finger-tip control:
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30° counter-clockwise, bleeds.
Panel mounting
Bulletin LV-10

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Flows to 1500 scfm.
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Bulletin R10A

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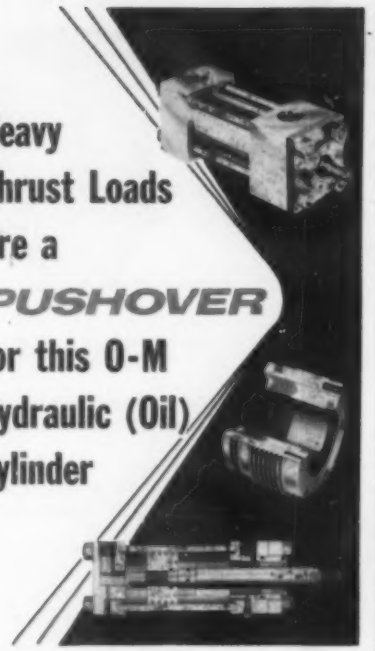

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Raymond is defining components in −300 F to +2000 F pneumatic systems.

Dr. D. H. Tsai of the U. S. Bureau of Standards talked about dynamic stability of pneumatic pressure reducers. A program to analyze dynamic stability was conducted at the Bureau's Pneumatic Laboratory.

• **Things to come**—A 7-paper symposium on advanced fluid power systems gave a look at future systems. E. A. Hitt, H. A. Poole, and A. E. Schmidlin of Walter Kidde analyzed hot gas control systems. Choice of propellant, servo valve, load considerations and feedback selection were detailed. Three present applications for gas servos are: aerodynamic controls, reaction controls, and thrust vectoring systems.

E. T. Raymond

. . . what comprises a hot gas system?

Five year, missile hydraulic system storage was described by Convair's Michael Voytish. His proposal eliminates fill, flush, and bleed equipment in the field because the factory seals the system before shipment.

J. S. Worrell of Martin-Denver revealed a technique that describes hydraulic performance by telemetered measurement of reservoir level. This measurement rapidly evaluates system performance from preflight tests.

Richard Ling of WADC outlined the principles for flight vehicle secondary power. He discussed power requirements for boost-glide vehicles and satellites. He also surveyed systems including static (fuel cells and batteries), chemical dynamic, nuclear and solar dynamic, and nuclear and solar static (energy converters).

Future space vehicles will probably need fluid power in three areas, reported C. H. Cannon of Lockheed Aircraft. Booster control actuation, engine gimballing, and re-entry actuation control will require hydraulic or pneumatic systems. Mr. Cannon said that, excluding solar energy, a liquid-propellant, gas generating system operating as an open loop source for hot gas utilizers is best for long operation. He recommends that hermetically sealed power sources be studied for such applications.

A two-part paper on piston actuation systems was presented by General Electric's M. A. Goldman and J. N. Shinn of the Aircraft Accessory Turbine Dept. They described a proportional system using a 2-stage, pressure control valve which maintains high response, even at high power levels. W. T. Rauch and L. R. Fenzel of General Electric's Light Military Electronics Dept. described a system using single-stage valves, including bang-bang, pulse-width modulated, and pressure feedback, single-stage servo valves.

One-shot valves for non-reusable missiles are now actuated by explosives. This saves weight and is simple. A manufacturer asked for a specification to cover their design and performance. He said that one of the troubles is the cartridge igniter becomes less reliable with repeated checking.

What is a hot system? W. Seamone of Johns Hopkins Applied Physics Laboratory said that many missiles operate at high temperature for very brief periods. He wanted specifications to say whether hydraulic components should be selected for steady state high temperature duty, or whether nominal temperature components should have their temperature limits raised for the short-time requirement called thermal shock. It was suggested that Class II components be modified. ▼▼▼

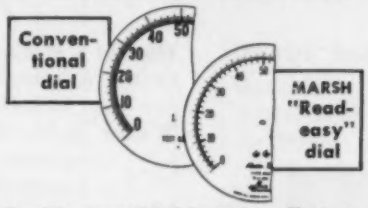
Circle **79** on Time-Saver Card

New MARSH "Master-Test" SERIES

Twin-tip pointer enables observer to read "dead-on" by lining up twin tips like gun sight.

Unprecedented accuracy and dependability in test gauges developed to meet today's exacting requirements. Each gauge individually *dead-weight tested!* Guaranteed accurate within ¼ of 1% plus or minus of maximum dial reading over entire range.

Mirror dial also insures accurate "dead-on" reading.



New "Read-easy" dial (patent pending), as illustrated above, assures reading accuracy in keeping with indicating accuracy. Also note three advanced means of reading available in all "Master-test" gauges: twin-tip pointer, mirror dial, and "non-parallax" dial as shown opposite.

Sizes 4½", 6", 8". All standard pressure ranges 0-15 psi to 0-30,000 psi, vacuum and compound.

"Non-parallax" dial has Plexiglas insert that assures accurate reading even when read at angle.

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HADBAR also custom molds and extrudes this rugged proprietary compound into seals, clamps, diaphragms and other products for a wide variety of applications in many critical areas of advanced design fuel, lubricant and hydraulic systems. It may be the answer to your problem . . . get in touch with us . . . we have the skills and facilities to help you.

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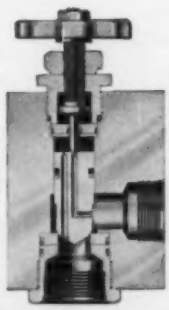
HIGH PRESSURE NEEDLE VALVE

10,000 psi hydraulic service. Forged stainless steel one-piece body. Panel mounting. Good flow characteristics, fine metering, easy to turn. Water, gas, oil and vacuum service, ⅛" to ½" pipe or straight thread tube connections.

MICROMETER ADJUSTMENT NEEDLE VALVE

Best for extra fine metering. Micrometer adjustment, precision taper stem. 5000 psi service –65° to 350°F., oil, water, etc. Brass, aluminum alloy, steel, or stainless steel body. ⅛" and ¼" sizes. Premolded or O-ring packing. Panel mounting.



5000 psi THROTTLE-FLO VALVE

Accurate throttling up to 5000 psi. Finger tip control. Pilot operation of large dynamically balanced piston. Full flow, yet accurate to 1/100 gpm through entire range. Positive seal. Low pressure drop. Aluminum alloy, ½", ¾", 1" internal straight thread connections. Hydraulic seals — others available.

HYDRAULIC BLEEDERS

Primarily used for bleeding air from hydraulic systems, for working pressures to 3000 psi at temperatures from –65° to 180°F.

Fluid control valves of many types have been developed and are manufactured by REPUBLIC. A wide line of quality standard valves includes needle, globe, check, plug, selector and relief valves, as well as other units for industrial, chemical, aircraft, missile and ground handling equipment.

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Simple or Complex
FROM JUST A SPEC

MC • DESIGNS
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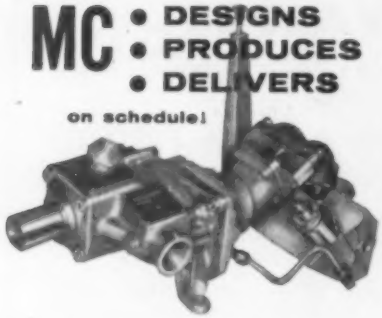
on schedule!



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at every step

In this package MC has condensed many functions:

Solenoid, pilot, two speed 24 GPM Valve, 3000 psi motor, relief, filters, restrictors, timers, bypasses, manual modulating override gears, two output shafts 8000 RPM.

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Fall . . . *the original*
SPRING-LOADED

Wiper **Ring**

This patented closed joint ring provides squeeze - grip action, assuring complete contact on the rod at all times. Maintains uniform, continuous pressure on wiper edge. Rods are always clean in any temperatures.

Fall "CJ" Wiper Rings operate most effectively under extreme conditions of dust, glaze, oil, grit, powder, gases, sand, ice, etc. Available in diameters ½" through 13". For any commercial use. Used by military and aviation industry since 1944.

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Est. 1935

Circle 2 on Time-Saver Card

AVIATION NEWS

from the fluid power field

DAVIS JOINS AH&P BOARD

Howard D. Davis of **Convair Astronautics Division** of General Dynamics Corp. has joined the

Howard D. Davis

Aviation Advisory Board of APPLIED HYDRAULICS & PNEUMATICS. With Convair since 1955, he has been engaged in fluid dynamics design as assistant design group engineer responsible for Atlas and Vega missile GSE hydraulic systems development. Mr. Davis is a member of SAE A-6D Missile Hydraulics subcommittee.

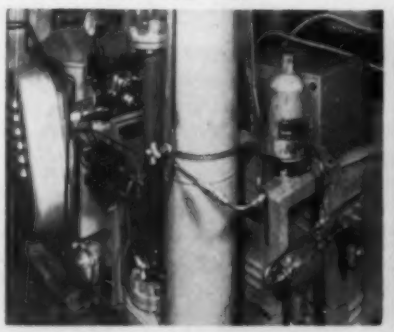
Donald J. McCaffrey is the new Central Atlantic district manager for the **Aviation Division, Walter Kidde & Co.** His territory comprises Long Island (N.Y.), Connecticut, and Rhode Island.

Robert A. Dickson has assumed the post of Northwestern district manager. Offices are located at Mercer Island, Washington.

TEST FACILITY PLANNED FOR FLORIDA

A new environmental test facility to be built in Orlando, Florida will be equipped with advanced testing devices for environmental, qualification and reliability testing of all types of aircraft and missile components and systems. **Associated Testing Laboratories, Inc.** will operate the laboratory to fulfill contracted testing for the Martin Company of Orlando.

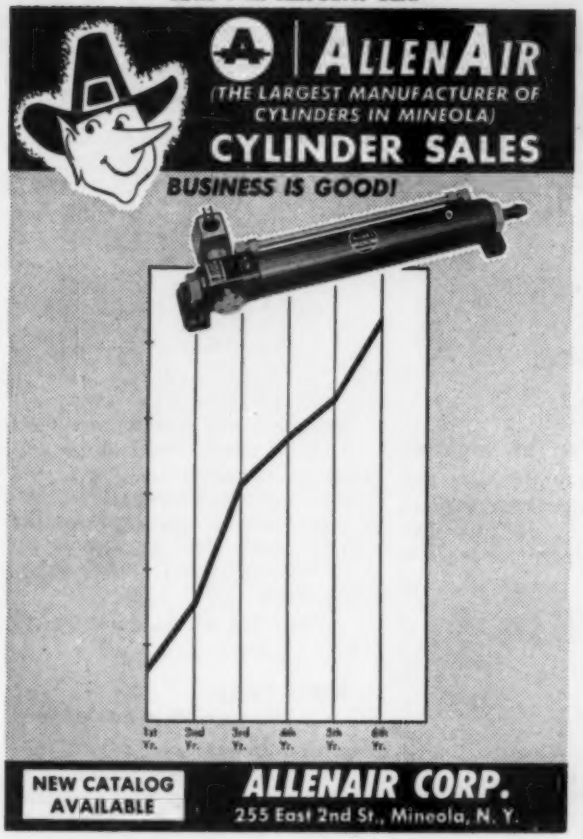
HOT FLUID TEST RIG



Moog Servocontrols, Inc. has a high temperature test facility for the development of servovalves and servoactuators with fluid temperatures up to 700 F. Supply pressures can reach 1000 psi with 2½ gpm flows. Ambient temperatures can be a maximum of 1200 F.

For performance measurements, valve output is piped to an external lapped sealed actuator. The valve null shift is measured as a d-c current in a closed loop circuit by which the actuator is slaved to a cycling input command. Valve dynamic response can be determined by actuator velocity to valve current relationship.

Circle 9 on Time-Saver Card



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SEARLE
If you want extra quality... extra service... see SEARLE!
Write for our complete illustrated catalog.
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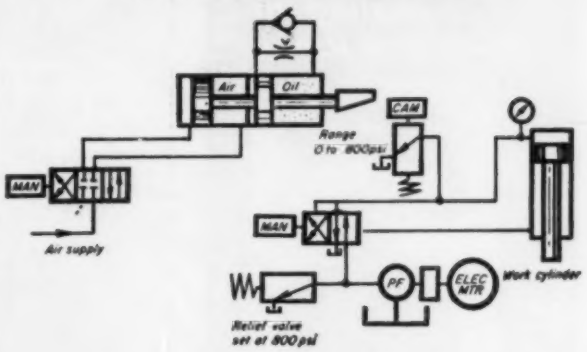
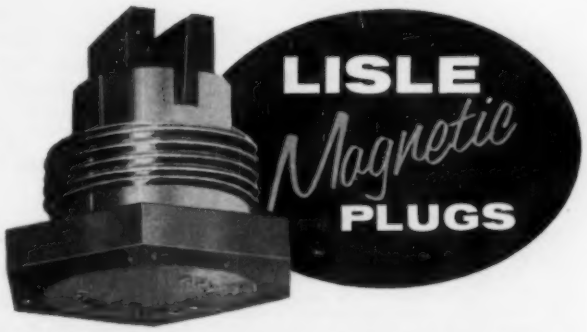
HYDRAULIC SYSTEMS PERFORM BETTER



...when equipped with



Ferrous metal particles circulating in the fluid of a hydraulic system are a primary cause of fouled valves and excessive pump wear.

You can eliminate this problem by installing a Lisle Magnetic Plug in the flow path or sump. The powerful magnet in the Lisle Plug attracts and holds these ferrous particles; prevents them from interfering with the proper functioning of the hydraulic system.

LISLE CORPORATION
CLARINDA • IOWA

Write for Catalog and Test Samples

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CHOICE OF TWO DESIGNS...

Palmetto PYRAMID® PACKINGS

. . . for effective sealing on Rods and Rams

This *advanced* form of V-type packing is offered in two distinctive designs for broad hydraulic and pneumatic service. Sets of *shallow* Palmetto Pyramid serve where the packing space is limited . . . *deep* Palmetto Pyramid sets are used where space is not a factor. Both designs have strong, heavy walls to resist extrusion — extend packing life.

In addition to Palmetto's unique adaptation of the "V" concept there is more to Palmetto Pyramid Packings than meets the eye. Reinforced styles, for example, are constructed with continuous plies of fabric — endlessly folded — that follow the molded form to withstand stresses exerted from all directions. Quality materials throughout, also not readily discernible, contribute to the performance you seek.

Palmetto's recommendations concerning the use of Pyramid Packings can be made quickly and accurately when the following is supplied:

• Your drawing showing dimensions and tolerences of the stuffing box and rod and of the piston and cylinder • A description of the fluid • Maximum pressure • Minimum and maximum temperature • Speed and direction of motion

SEND FOR LITERATURE—

Let us help you design-in a more effective seal. For complete technical data on Palmetto Pyramid Packings request your complimentary copy of Bulletin PY-959.

NOTE: Another useful packing fact book, just printed, is available to design engineers. Ask for Bulletin GTR-759 covering Palmetto O-T Rings.

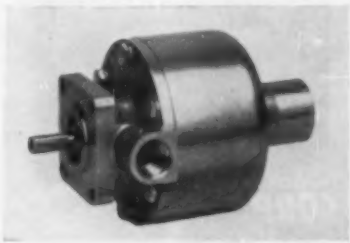
GREENE, TWEED & CO.
NORTH WALES, PA.

Circle **54** on Time-Saver Card

AVIATION COMPONENT DATA

Fuel Pump . . . for jet engines.

With fuel flow rates of from 400 to 50,000 pounds per hour, at pressures to 1500 psi, these fixed displacement, vane-type, pumps save

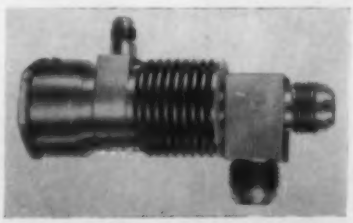


to 25% in weight. All pumping parts are contained in a replaceable cartridge for simplified maintenance. Designed for 1000 hour reliability.—*Vickers Inc., Detroit, Mich.*

Circle **500** on Time-Saver Card

Valve . . . is pilot-operated

This valve is used to lower pressure in a solid propellent gas chamber and stop combustion. It



may also be adapted to actuate cylinders or modulate flow.—*Aero Supply Manufacturing Co., Inc., Corry, Pa.*

Circle **501** on Time-Saver Card

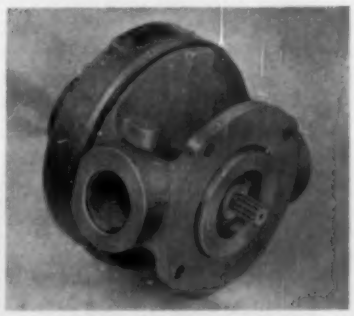
Systems & Components . . . in new brochure

Specific performance data and design perameters are given for pneumatic and hydraulic regulators used for missile fuel tank pressurization, pneumatic steering, and instrument air bearing supply. Pressure switches, rapid response relief valves and other components described.—*Wallace O. Leonard, Inc., Pasadena, Calif.*

Circle **502** on Time-Saver Card

Boost Pump . . . is direct-driven

Delivering 31 gpm at 3450 rpm, this pump's speed matches prime mover rpm. Direct drive eliminates gear trains, belts, and clutches. Inlet



conditions vary from 125 psi to 18" mercury. Gives instant fluid supply to high pressure piston pumps on missile and aircraft test stands.—*Double A Products Co., Manchester, Mich.*

Circle **503** on Time-Saver Card

Modular Regulators . . . in new bulletin

Bulletin A-300 describes cartridge style pressure compensated hydraulic flow regulating valves. The modular design saves weight and space, cuts maintenance costs and eliminates the possibility of improper installation. Reliability is increased due to the reduced number of leak sources.—*Waterman Engineering Co., Evanston, Ill.*

Circle **504** on Time-Saver Card

Switching Servovalve . . . for missile use

Acceleration switching servovalves are in volume production. Resolution is less than one part in 10,000 based on maximum valve input signal; zero hysteresis. These

valves have inherent features that make them more tolerant of fluid contamination. Bulletin 106 describes operating principles, performance and application.—*Moog Servocontrols, Inc., East Aurora, N. Y.*

Circle **505** on Time-Saver Card

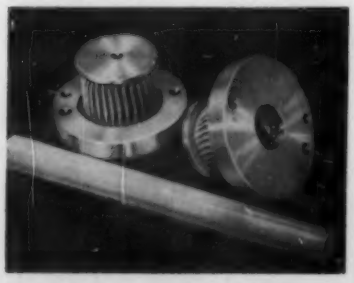
Hydraulic Pump . . . for aircraft

The AP6V airborne hydraulic pump uses unique 2-stage operating principle. Delivery is about 16 gpm at 3750 rpm and 3000 psi. Weight is only 15 pounds. A brochure is available describing characteristics, performance and design principles. —*Kellog Div. American Brake Shoe Co., New York, N. Y.*

Circle **506** on Time-Saver Card

Filter and Relief Valve . . . is small, light unit

The smallest precision filter with a relief valve weighs only 1.18 ounce, and is rated at 2 microns, 15 microns absolute. It operates at 0.3 gpm normally and 0.8 gpm under



intermittent surge. Temperature range is —65 F to 275 F. Cracking pressure is 150 psi. All stainless steel construction.—*Aircraft Porous Media, Inc., Glen Cove, New York.*

Circle **507** on Time-Saver Card

Continued on next page

NOW YOU *CAN* USE BANJO FITTINGS IN YOUR DESIGNS!

Some years ago, this famous space-saving fitting lost favor with engineers due to the difficulty of sealing them properly. But *now*, Banj-O-Seals* make the use of banjo fittings popular again! Banj-O-Seals* are a development of Parker Seal Company, using the famed one-piece Stat-O-Seal* design. They make it easy to seal "banjo" fittings . . . they are easy-to-install, easy to remove and *they provide no-leakage sealing*. Proof of the pudding? . . . Banj-O-Seals are retrofit on nearly every leading airline!

Stat-O-Seals*, also seal bolts, studs and other fasteners . . . self-centering, re-useable, easy to install.

write for free catalog and literature.

. . . another example of "seal-for-sure" designs by . . .

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Circle **92** on Time-Saver Card

HIGH SPEED GEAR PUMPS FOR THE NEXT GENERATION

OF AIRCRAFT • MISSILES • SPACECRAFT

High performance hydraulic pumps by Eastern are uniquely suited to the exacting operating requirements demanded in the craft of tomorrow.

Check these Eastern gear pump features — do they suggest a solution to your present design problem?

Small size: Eastern gear pumps are the smallest, lightest made. Airborne servo system pump shown delivers 1.5 gpm @ 1500 psig — measures only 1⅞" x 1⅞" x 2¼", weighs 9 oz.

Wide performance range: pumps available have theoretical displacement from .0016 to .0419 cu. in. per revolution — flow from .025 to 2.0 gpm, pressures from 0 to 2000 psig, at speeds to 24,000 rpm. Weights with motor range from 1.5 to 8.5 lbs.

Unaffected by extreme environments: rugged, reliable Eastern units take loads to 50g in stride — shrug off temperature differentials to meet MIL specs.

Flexibility, economy: mass-produced components can be teamed into the precise configuration you need. Creatively-engineered custom pumps also available.

Contact Eastern for creative contributions to help you solve your hydraulic pump or power problems. Write for Bulletin 360 — your complete new guide to Eastern aviation products.

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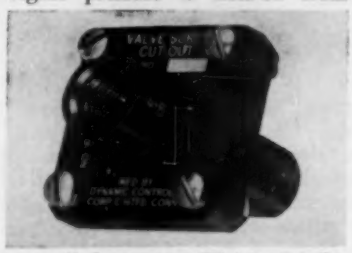
Circle **44** on Time-Saver Card

AVIATION COMPONENT DATA

Air Valve . . . is sensitive

Air-operated valve shifts from fully open to fully closed with 1 psi or less signal pressure change. Signal pressure is isolated from



controlled pressure. Weighs 0.3 lb., temperature range to 360 F.—*Dynamic Controls Corp., East Hartford, Conn.*

Circle **508** on Time-Saver Card

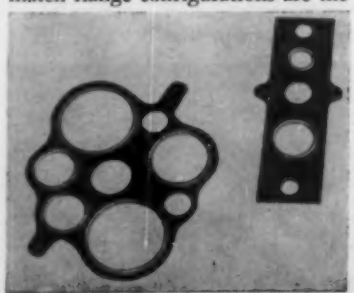
POWER PACKAGE . . . is lightweight

Short-time, high peak power is provided by the No. 64-2415-000 unit, weighing 27 lbs. Requiring 24 volt d-c, 30 amp input, its output is 600 to 1400 psi at 10 gpm for periods to 2½ seconds. Available in other pressure ranges, sizes and configurations.—*Aero Supply Co., Corry, Pa.*

Circle **509** on Time-Saver Card

Retainers . . . for O-ring assemblies

Several metallic O-rings incorporated into a single assembly to match flange configurations are the



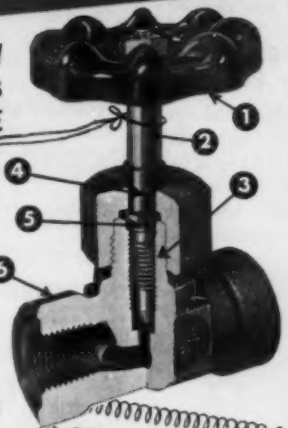
latest in O-ring application ideas. Metal O-rings in the same unit are of the same cross section and wall thickness. Advantages of this plate design are easy handling, automatic positioning, and controlled hoop tension.—*United Aircraft Products, Inc., Dayton, Ohio.*

Circle **510** on Time-Saver Card

Circle 62 on Time-Saver Card

THE INSIDE STORY

ON THIS VERSATILE, NEW
100 SERIES
GENERAL PURPOSE VALVE



1. Diecast Aluminum Handle
2. Centerless Ground Stem
3. Safe, Integral Bonnet
4. Exclusive Nylon Stem Wiper
5. GUARANTEED Leak-proof O-ring Seal
6. Rugged, Forged Carbon Steel Body in Globe or Angle Pattern

The new Series 100 line of full-flow, general purpose valves offers unusual features at a competitive price. Use for throttling, regulating, shut-off; over temperature range of —40 to 200°F. Male and female connections. Panel mounting, too. Send for FREE SAMPLE VALVE on your company letterhead.

GUARANTEED
against stem leakage
From non-critical vacuum to 10,000 psi.

HOKE

HOKE INCORPORATED
Fluid Control Specialists
87 PIERMONT ROAD, CRESSKILL, N. J.

SAVE ON NEW & SURPLUS HYDRAULICS

NEW PALLEY HYDRAULICS

Here are two of our newly developed line of double action Industrial Hydraulic Cylinders. These cylinders are designed to meet the most rigid requirements of industry. All are heavy duty steel construction. SAVE!

Type (A) is a heavy duty, press type cylinder with bores of 3", 5", 6" and 8" — thrust ranges up to 75 TONS at 3000 PSI.

Type (B) is an internal cap type cylinder with bores of 1-1/2", 2", 2-1/2", 3", 3-1/2" and 4". Has a thrust range of 2" to 48". Delivers up to 18,850 lbs. of thrust on 1500 PSI line pressure.

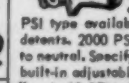
For COMPLETE LISTING of our tremendous ON-THE-SHELF stocks and prices — Send for Cat. H-59.

3000 PSI HAND PUMP

Operates up to 3000 PSI. Has a built-in return flow check valve. Inlet port ½" AN, outlet 1/4"AN. No. HP-30 Only 22.50

1500 PSI Hydraulic HAND PUMP Displaces 0.19 GPM at 30 cycles per min. Capacity 1.5 cu. in. per cycle. No. HP-3U 6.88

NEW HEAVY DUTY SLIDING PISTON 4-WAY VALVE



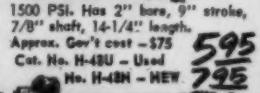
Available in Open or Closed Center. 3000 PSI type available with spring return or detents. 2000 PSI type has spring return to neutral. Specify type needed. Both have built-in adjustable relief valve. Maximum flow is 10 GPM. Order either 2000 or 3000 PSI type. SAVE at our LOW PRICES!

2000 PSI type $24.50
3000 PSI type $32.75

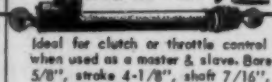
STRATO POWER HYD. PUMP

Delivers 10 gal. per minute at 1500 RPM at 3000 PSI. Pressure is adjustable from 2800 to 3800 PSI. A variable displacement, piston type. Displaces 1.694 cubic in. per revolution. 99.50

DBL. ACTION HYD. CYLINDER



1500 PSI. Has 2" bore, 9" stroke, 7/8" shaft, 14-1/4" length. Approx. Gov't cost —$75
Cat. No. H-48U — Used 5.95
No. H-48N — NEW 7.95



Ideal for clutch or throttle control when used as a master & slave. Bore 5/8", stroke 4-1/8", shaft 7/16", length 9-5/8". Parts 1/4" tube. NEW. Cat. No. H-60 3.75

NOTE: We stock the largest ON-THE-SHELF stock of Hydraulic Equip. in the World. Stocks include Hydraulic Pumps, Valves, Cylinders, Motors, Hose and fittings of all kinds. Write for Catalog section H-59 and SAVE!

Pay by M.O. or Check. P.O.s accepted from D&B firms rated P2½ or better. 1/2 deposit with C.O.D.s. Prices F.O.B. Los Angeles Whse.

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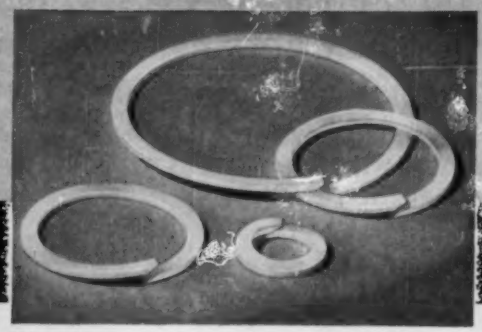
2263 E. Vernon Ave. Dept. AH-129, Los Angeles 58, Calif.

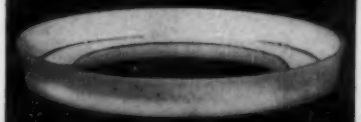
Circle 90 on Time-Saver Card

PRECISION
H·I·S TEFLON*
for LIFE-TIME & TROUBLE-FREE
HYDRAULIC SERVICE

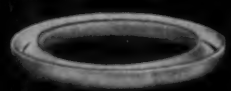


Single Turn Back-up RINGS . . .
ALL THE NEW MILITARY SIZES —
MS-28774, MS-28777 and MS-9058.
Accurately machined to assure you the fullest utility range and life of your equipment.

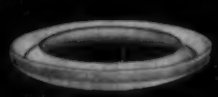
Only HALOGEN offers "MEMORIZED" TEFLON



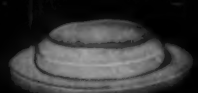
Style 310 Piston Cups



Style 614 V Rings



Style 410 U Cups and Blocked Vees



Style 210 Flange Seals

Halogen cylinder packing is known for operating successfully and efficiently over the widest temperature and pressure ranges . . . because they are "MEMORIZED".

This is an EXCLUSIVE process which makes the packing lip "remember" the size of the rod or cylinder . . . and keeps it in sealing position, regardless of temperature variations.

Send your prints for assembly details and find out about FIELD PROVEN AND ENGINEERED "TEFLON by HALOGEN."

Write for complete catalog on "TEFLON HYDRAULIC SEALS" . . . it's FREE!

HALOGEN
INSULATOR & SEAL CORP.
9960 Pacific Avenue, Franklin Park, Illinois, GLadstone 5-9000
Engineers and manufacturers of products of TEFLON *DuPont T.M.

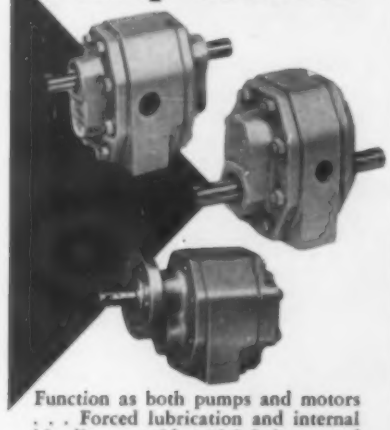
Circle 57 on Time-Saver Card

Offered you...

...by the world's largest builders of hydraulic jacks

PRECISION-ENGINEERED PRECISION-MACHINED INDUSTRIAL HYDRAULIC EQUIPMENT

Pump-Motors



Function as both pumps and motors . . . Forced lubrication and internal bleeding provide axial balance and eliminate high pressures against oil seals . . . Rotation in either direction . . . Heavy-duty roller bearings . . . Small cube space . . . 8, 17, 25 GPM at 1000 PSI . . . Gear type, constant displacement.

Control Valves

Large oil passages . . . Close grained, high tensile alloy body castings . . . 2 types of action . . . Spring centered, ball detent hold . . . Hardened ground spool . . . Precision honed valve body . . . Pressure relief valve . . . Hardened seat insert for long life.

Engineering ingenuity in designing and manufacturing hydraulic systems and assemblies to your own exacting specifications.

5008

Hein-Werner Corporation

Please write to
HEIN-WERNER CORPORATION
Waukesha 4, Wisconsin

Circle **60** on Time-Saver Card

NEW PRODUCTS

Continued from page 60

HYDRAULIC CYLINDERS . . . for 2000 psi

Features: Interchangeable cushion adjustment and check fit flush into cylinder's end plates. One-piece piston has solid head for quick bleeding. No air pockets. Internal pressure reduces radial clearance at

pilot fit, to check O-ring extrusion. Self-contained cartridge removes without loosening tie rods, removing retainer plate, or dismantling cylinder. Inserts lock piston to rod. No nuts, set screws, or lock pins needed. Thread strength maintained when piston or rod replaced.

Specifications: 12 bore sizes from 1⅛" to 12". 23 mountings, 4 rod ends.

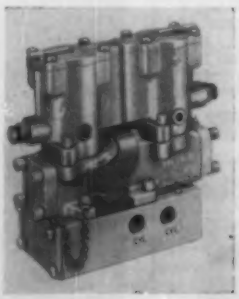
S-P Manufacturing Corp.
Solon, Ohio

Circle **316** on Time-Saver Card

CONTROL VALVES . . . have built-in plugs

Designation: Speed King

Features: 4-way, 1¼" valves in single and double solenoid types, for sub-base or multiple manifold mounting. Control valves have one-piece pilot housings. Bodies, sub-bases, end caps, and O-ring spacers



are aluminum. Built-in plugs and connectors in pilot, valve body, and sub-base complete electrical connections when body and pilot are bolted into place. Double solenoid types have four-wire circuits. Only pilot plungers and springs move in pilot. No springs in main valve.

Specifications: For 30-200 psi service. Solenoid coils for a-c, d-c, any voltage. Cylinder ports and inlet are tapped ¼"; exhaust, tapped ⅜". Port, mounting locations identical on single and double solenoid types. Manual over-ride optional. Foot-mounted valves without plug-in feature are available.

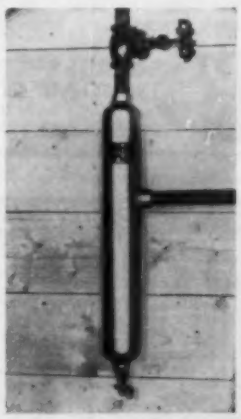
Valvair Corp.
Akron, Ohio

Circle **317** on Time-Saver Card

PURIFIER . . . has liquid reservoir

Designation: Type LCR Hi-eF Purifiers

Features: Purifier cleans air and steam lines to 2" in size. Needs no drainer. Manual drain valve blows down unit. In compressed air systems, unit removes moisture which



forms downstream from aftercoolers; clean air goes to tools. Centrifugal scrubbing removes moisture, particles. No moving parts.

Specifications: Forged steel bodies, stainless centrifugal elements. For 400 psig, 500 F service.

V. D. Anderson Co.
Cleveland, Ohio

Circle **318** on Time-Saver Card

RINGS & SEALS . . . in three types

Features: All-metal seal was tested at 10,000 psi static, 5000 psi pulsating. Temperature range is —70 C to 300 C. Some metal seals tested to 600 C. For lower pressures and temperatures, nylon seal uses bonded seal lip configuration (Dyna Seal). Lobes around internal

Continued on page 120

Circle **17** on Time-Saver Card

Something really **new**

full ported - direct lift

SOLENOID VALVES

by

Atkomatic

Feature the new *wramic* solenoid that assures reliable operation regardless of line pressures.

•

PORT SIZES to **3"**

PRESSURES from **ZERO** to **3,000** psi

Available in bronze or stainless steel

Send for Bulletin S-1

ATKOMATIC VALVE COMPANY, INC.
545 West Abbott Street • Indianapolis 25, Indiana

NEW!

WR

SEQUENCE CONTROLLER

combines

flexibility and economy

Announcing a new electrically operated control device with unusual flexibility. Switches from 2 to 12 circuits in any predetermined sequence. Almost infinite number of sequences and sequence combinations possible. Costs less initially . . . inexpensive to install and operate. Get all the facts and specifications, including detail drawings. Write for SC-500 literature today!

WARCO Industries, INC.
6625 Delmar Blvd. • St. Louis 30, Mo.

Circle **120** on Time-Saver Card

Circle **77** on Time-Saver Card

GREATER PROTECTION to your AIR LINE!

M·B

WHIRL-A-WAY FILTER, REGULATOR AND LUBRICATOR ASSEMBLY AND AUTOMATIC AIR TRAP (MODEL W-4)

SUCCESSFULLY USED FOR PROTECTION OF AIR VALVES CYLINDERS CONTROLS PNEUMATIC TOOLS, ETC.

The FILTER removes solids .00039 and larger. Transparent bowl provides visibility. The REGULATOR can pass large volume with an unrestricted flow and minimum pressure drop. Self-bleeding, compact.

The LUBRICATOR delivers desired volume of oil. Bowl can be refilled without shutting off air supply.

The Air Trap is automatic and eliminates manual draining.

M·B PRODUCTS
46 VICTOR AVE., DIV. 10
DETROIT 3, MICHIGAN

Kep-O-seal

Kep-O-seal Kep-O-seal

Kep-O-seal

Flexible Seal Seat * VALVES

- **CHECK VALVES**
- **RELIEF VALVES**
- **SHUTTLE VALVES**
- **CARTRIDGE VALVE INSERTS**

Specify Kep-O-seal! — leakproof construction designed for efficient fluid flow and reasonable cost. This name is your assurance of quality; backed by two generations of specialized service to industry.

*PAT. APP'D. FOR.

Write for Complete Detailed Information.

KEPNER PRODUCTS COMPANY
7321 West 59th Street Summit, Illinois

Circle **71** on Time-Saver Card

Portable Hydraulic Power Pumps
10,000 psi intermittent
6,000 psi continuous

No. 797-E-SA

No. 797 series
213 cu in. per min. at 10,000 psi

Extra-high-speed drive at high pressure. Applies to a wide range of hydraulic systems. Compact unit . . . pump reservoir, and control valve in one housing. Simply operated, 2-position control handle with advance and return positions. Available with 4-way valve for double-acting rams. Delivers 213 cu in. of oil per min at 10,000 psi with 3 hp a-c motor . . . 106 cu in. with 2 hp motor.

No. 797-G-SA is same pump powered with 4½ hp 4-cycle, air-cooled gasoline engine.

No. 798 series
28 cu in. per min.
. . . at 10,000 psi

Easily carried, high-pressure pump. Has exclusive fast approach . . . high volume, low pressure . . . automatic change-over to low-volume, high-pressure drive. Develops 6,000 psi continuous pressure, 10,000 psi intermittent. Choice of integral 2-way or 4-way valve. Built-in 115 - 230 V ¾ hp a-c motor. Also available with built-in 1.7 hp gasoline engine, universal or low-voltage motor. Write for illustrated data sheets.

ALSO A SELECTION OF HYDRAULIC HAND PUMPS AND VALVES

GREENLEE TOOL CO.
1775 Columbia Avenue
Rockford, Illinois

GREENLEE

Circle **53** on Time-Saver Card

NEW PRODUCTS

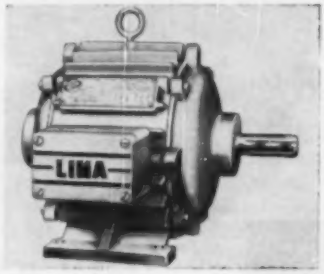
diameter help seal hold shape. E-ring resembles U-ring, has central locating ring molded integrally between lips of U. Improves assembly, tightening.

Dowty Seals, Ltd.
Ashchurch, England

Circle **319** on Time-Saver Card

FAN DUTY MOTOR
. . . has external cooling fins

Designation: Type EFD



Features: Motors are totally enclosed, have seasoned cast iron frames with integral feet. Double-width ball bearings have lubricant sealed in for motor's life. Connection box rotates for easy connecting. Cooling surfaces are accessible for cleaning.

Specifications: Motors rated at ½ to 15 hp. Speeds are 900, 1200, and 1800 rpm. Continuous duty rating, temperature rise rated at 55 C. Rerated NEMA frame sizes 182 through 326U.

Lima Electric Motor Co., Inc.
Lima, Ohio

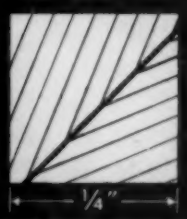
Circle **320** on Time-Saver Card

HYDRAULIC PEAK PRESSURE GAUGE
. . . for troubleshooting

Features: Personnel unfamiliar with electronic equipment can use gauge to troubleshoot and correct hydraulic systems under excessive transient pressures. Contains pressure pick-up, amplifier, peak detector. Meter indicates true absolute peak of pressure transients as short as one millisecond in duration. Meter deflects rapidly to peak, decays slowly to system's steady state pressure. During decay, transient of pressure level higher than instantaneous meter

PISTON LEAKAGE PROBLEMS ? ? ? CHANGE TO "STEP SEAL RINGS"

CROSS SECTION OF "STEP SEAL" JOINT



See the newest revolution in sealing rings by AUTO-DIESEL PISTON RING CO. The "STEP SEAL RING" has a sealing action over the entire area. This results in a ring that allows only ⅛ the leakage under—15 times the pressure of a straight cut ring—see comparison table below.

COMPARISON TABLE

STRAIGHT CUT COMPRESSION RING	"STEP SEAL RING"
With .005" end clearance has leakage rate of 150cc/min. at 400 lbs. pressure.	With .010"-.020" and .030" has a leakage rate of only 25cc/min. at 6000 lbs. pressure.

To reduce leakage to a minimum specify "STEP SEAL RING"

For complete details write for Bulletin H-57

THE AUTO-DIESEL PISTON RING CO.
3141 Superior Avenue • Cleveland 14, Ohio

Circle **18** on Time-Saver Card

reading causes meter to deflect to new peak.

Specifications: Front panel has output terminal for oscilloscope or oscillograph. Gauge then becomes

pressure amplifier with full scale (0-4000 or 0-10,000 psi) output of 40 volts, frequency response of 0-1000 cycles per sec.

Hydel, Inc.
Waltham, Mass.

Circle **321** on Time-Saver Card

SOLENOID VALVES
. . . for high pressures

Designation: Type R Series

Features: Two-way, normally closed, pilot-operated valves are for use with air or liquid. Spring-loaded plunger and piston assembly pro-

vides positive closing. Mounts in any position.

Specifications: Standard or explosion-proof construction. Bodies are of forged naval brass; all internal parts, stainless steel. ¼" diameter orfice, ¼" NPTF ports. Operating pressure differentials: 5 to 1250 psi on a-c voltage; 5 to 1000 psi on d-c.

Skinner Electric Valve Division
New Britain, Conn.

Circle **322** on Time-Saver Card

STARTERS & CONTACTORS
. . for constant speed motors

Designation: Model 58 RA

Features: Across-the-line magnetic controls for NEMA sizes 0 and 1 for single and polyphase operation. Non-softening, epoxy-resin molded coil casing provides protective shell against environmental and mechanical damage, dissipates heat well. Coil is vacuum impregnated to eliminate hot spots. Solderless terminals. Straight-through, up-front wiring is standard. General purpose enclosures and fully wrap-around type to facilitate installation, wiring, inspection, and maintenance.

Specifications: Rated to 7½ hp at 220 volts; 10 hp at 440 and 550 volts.

Arrow-Hart & Hegeman Electric Co.
Hartford, Conn.

Circle **323** on Time-Saver Card

CYLINDERS
. . . use new solenoid valves

Designation: Pneuland

Features: Solenoid coils are interchangeable. Integrally-mounted double solenoids operate cylinders.

Specifications: Solenoids interchangeable on valves from ¼" BSP 2-way to 1" BSP 4-way, and 1½" BSP 3-way. Coils: 12-440 volts, 50 cycles; 120 and 200 volts, 60 cycles; 12-250 volts d-c. Rod of 1½' bore, double-acting, double-

Continued on next page

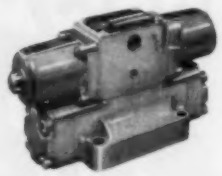
NEW!

H-P-M 4-WAY VALVES

with Smoother Acting,
Longer Lasting Oil-Immersed Solenoids

These new H-P-M pilot operated 4-way valves are completely interchangeable with industry standards. They feature oil-immersed solenoids to lessen shock and reduce pounding and wear. They last 20 to 30 times longer than air-gap types. Cost? . . . only a few dollars more than conventional air-gap solenoids, a small investment for better machine operation and longer, maintenance free service.

AVAILABLE FROM STOCK FOR IMMEDIATE DELIVERY



¾" Pilot operated, solenoid controlled; 3000 psi, 20 gpm.

NEW!

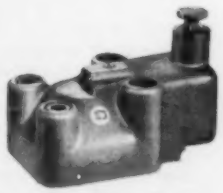
H-P-M RELIEF VALVES

Low override
High Cracking Pressures

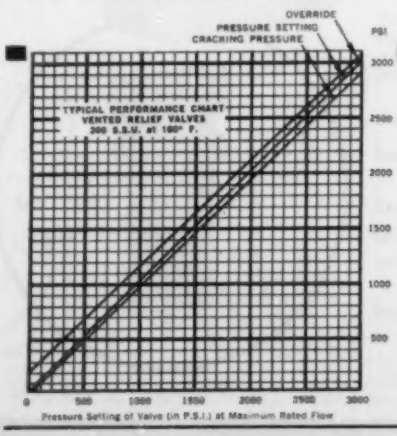
Close control of cracking and override pressures is graphically illustrated in the performance chart. These valves are built to protect the circuit from harmful over pressure conditions, assure accurate application of pressures to desired preset requirements and to conserve horsepower.

AVAILABLE FROM STOCK FOR IMMEDIATE DELIVERY.

Completely interchangeable with industry standards.



⅜", ¾", 1¼" Sizes; 3000 psi, 0 to 65 gpm



H-P-M CYLINDERS
300 to 3000 psi
1½" to 12" Bore, standard. Specials built to specification

H-P-M PUMPS
Variable Displacement
5 to 185 gpm
3000 psi max.

HPM H50

THE HYDRAULIC PRESS MFG. COMPANY

A Division of Koehring Company, Mount Gilead, Ohio, U.S.A.

Circle **66** on Time-Saver Card

NEW PRODUCTS

foot mounted cylinder goes through both cushioned ends. 4" stroke. 2¼" bore cylinder of same type has 9¾" stroke. 1½" bore, double-acting, flange-mounted cylinder has ⅜" stroke.

Lang Pneumatic, Ltd.
Wolverhampton, England

Circle **324** on Time-Saver Card

BACK PRESSURE REGULATOR
. . . to 250 psi

Designation: No. 1165, 1265

Features: Short-stroke metal diaphragms. Sliding gate seats slice across flow to give balanced action. Self-cleaning, self-lapping seats insure tight shut-off. Stainless steel pilot seat has Teflon center.

Specifications: No. 1165 is of ductile iron; No. 1265, of bronze. For pressures to 250 psi wsp, temperatures to 500 F. Control 50-6600 lbs. of steam per hour or 7-190

gallons of water per minute. Sizes from ½" to 2".

OPW-Jordan
Cincinnati, Ohio

Circle **325** on Time-Saver Card

Capital

HYDRAULIC FILTERS

for Hydraulic and Oil Re-circulating Machinery

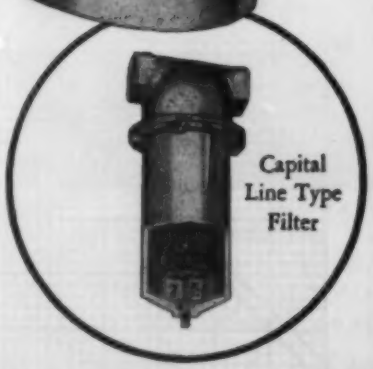
Capital Hydraulic Filter Units are smaller than ordinary filters but with filtering capacity equal or superior to many larger filters. Small size permits greater latitude in design, particularly where space is restricted.

Capital Filter Units are designed with one-piece construction — no screws or nuts to work loose and be lost or mislaid. Simple and easy to clean by any method.

Made from specially designed woven Monel wire, with narrow corrugations presenting the greatest filtering area. Monel support supplies extra sturdiness.

Capital Filter Units are made in 4 Types:

- **MONO-BILT 60 Mesh All Stainless Steel (Sump type).**
- **MONO-BILT Standard All Stainless Steel**
- **MONO-ECONO Mono-Bilt with Monel Metal Insert and Cadmium Plated Top and Bottom.**
- **LINE TYPE with Aluminum Housing and Mono-Bilt, one Piece Filter Unit.**



Capital Line Type Filter

Built from Monel Metal they are impervious to rust and corrosion.

CAPITAL ENGINEERING & MFG. CORP.

5836 SOUTH ASHLAND AVENUE, CHICAGO 36, ILLINOIS

Circle **28** on Time-Saver Card

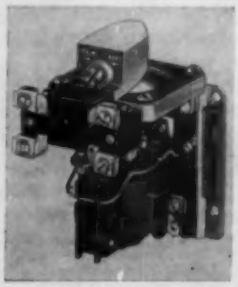
VITON SYNTHETIC RUBBER
. . . has been improved

Features: In 500-600 F heat aging tests, Viton flouroelastomers show better retention of elongation, less change in hardness than all other commercial types. Tensile strength is lower, but useful elasticity is prolonged, embrittlement is slower. Higher resistance to oil and solvents, especially to diester lubricants. Has normal compression set, higher tear and abrasion resistance. Won't support combustion. Solubility allows use as coating.

E. I. du Pont de Nemours & Co.
Wilmington, Del.

Circle **326** on Time-Saver Card

PNEUMATIC TIMER
. . . has closed air system



Features: Air system is internally ported for applications in dusty atmospheres. Uses no external air.

Specifications: Timing range from .2 sec. to 1 min. For a-c, d-c.

Square D Co.
Milwaukee, Wis.

Circle **327** on Time-Saver Card

Circle 81 on Time-Saver Card

MIDGET MUFFLERS Ready!

M-1 ONLY $1.95

Sensational!

Industry's handiest new devices! They're made from polyether foam enclosed in anodized aluminum — they silence noises caused by exhausting air. Rust-proof; common solvents clean 'em! Use M-1 or 2 for 1/8" or 1/4" exhaust ports; M-3 for 3/8" port. Order your Mead Midget Mufflers direct or send for name of nearest Mead Distributor.

Prices slightly higher West and Canada

M-2 $1.95

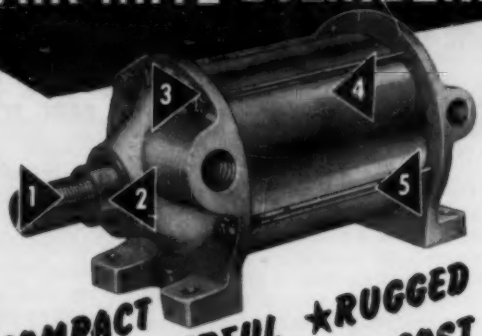
M-3 $2.50

MEAD SPECIALTIES COMPANY

4114 N. Knox Ave., Dept. AH-129 Chicago 41, Ill.

Circle 7 on Time-Saver Card

AIR-MITE AIR CYLINDERS



★COMPACT ★POWERFUL ★RUGGED ★LOW COST

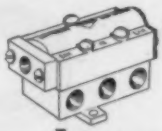
AIR-MITE Cylinders—made in Single or Double Acting Series, in 4 mounting types, are high quality cylinders at a low price. Simple, rugged design and compact construction give them long life, permit easy mounting on jigs, fixtures, tools, or machines. Used wherever power holding, pushing, pulling, or lifting is required, AIR-MITE Cylinders will meet your most exacting requirements of dependability and long life. Write for complete catalog and prices.

QUALITY FEATURES:

1. Ground and polished steel ram
2. Bronze oilless ram bushing
3. High strength aluminum alloy cylinder heads
4. Brass, true-bore cylinders
5. Five steel tie rods

AIR-MITE DEVICES, INC.

4401 W. Kinzie St., Chicago 24, Ill.



the best 4-way 1/4" single pilot valve made costs $21.00 at

ALKON

a dollar more gets you the best double pilot valve.

And the quality, like the price, is unbeatable. Working and sealing surfaces are so hard they won't wear out—ever! Alkon single and double pilot valves operate at vacuum to 200 p.s.i. Like all Alkon valves they are sub-base mounted at no extra cost!

ALKON PRODUCTS CORPORATION

200 Central Ave., Hawthorne, N. J.

ALKON

Circle **88** on Time-Saver Card

PRESSURE SWITCHES

for twice-a-second or twice-a-year operation!

An Oil-Dyne pressure switch has repeatability—it will function properly every time, whether it operates several times a second—or once every six months! Liberal use of low-friction materials and a completely new (patent applied for) design that eliminates all contact between O ring and cylinder walls combine to keep piston from sticking—assures perfect operation every time, any time. 50-5000 psi, explosion-proof. Single and duplex models. For hydraulic fluids and gases (freon, oxygen, etc.). Write for illustrated brochure.

PIONEERING MINIATURIZED HYDRAULIC ACTUATION

- PUMPS
- CYLINDERS
- PRESSURE SWITCHES
- VALVES
- ACCESSORIES

OIL-DYNE INC.

2115C West Marquette Road, Chicago 36, Ill.

USEFUL LITERATURE

Continued from page 62

SEAL FOR PIPE THREAD

Lock nut has tubular portion at its base. Split ring of reinforced polyamide compound is inserted into void between interior of tubular section and fitting groove. Edge is then crimped to retain resilient sealing medium. Can be used with standard SAE straight thread port. Withstands over 10,000 psi. No hydraulic fluid limitations. Report #2. *Imperial Brass Mfg. Co., Chicago, Ill.*

Circle **407** on Time-Saver Card

ROLLING DIAPHRAGMS, MANOSTATS

Long stroke, deep convolution, constant area diaphragm, free positioning, with complete relaxation at any point in stroke. Moves axially, rolls off piston sidewall onto cylinder sidewall with smooth and continuous frictionless motion. Often performs both bellows and diaphragm functions. Can replace cup packings and O-rings. Linear actuators utilize diaphragm. Diaphragm's self-aligning characteristics enable actuator to withstand severe mechanical abuses without affecting operation. Manostat is a pressure controller utilizing servo system. Pilot nozzle controls main valve action. Ample sized exhaust and supply seats give instantaneous adjustment of control pressure. Pilot pressure bled directly to atmosphere. Low air consumption, since lower regulator pressure is used for pilot energy. Extremely high gain. Brochure BF 301-A. *Bellogram Corp., Burlington, Mass.*

Circle **408** on Time-Saver Card

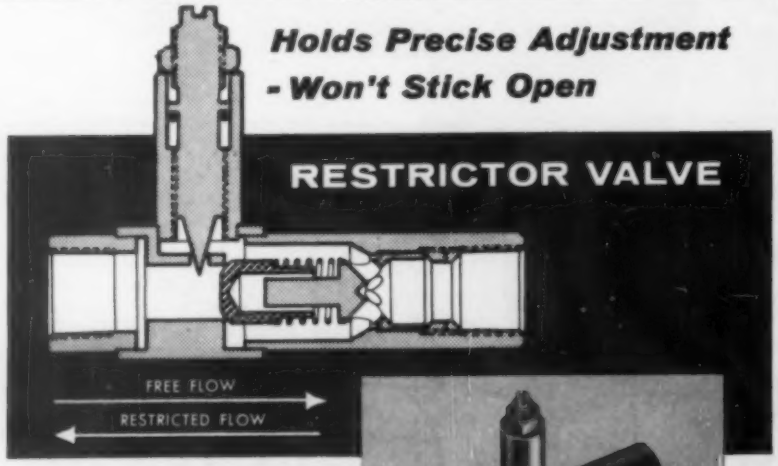
HEAT-EXCHANGER TUBES

Bulletin TB-431 covers manufacture of carbon-steel heat-exchanger tubing. Heat-treatment process eliminates differences of grain structure between weld and tube body. Tubes receive oxide finish in furnace. Flash is removed from inside and outside of tube. Tubing checked by chemical analysis, visual, ultrasonic and metallurgical inspection, and hydrostatic, magnetic particle, and deformation testing. *The Babcock & Wilcox Co., Tubular Products Div., Beaver Falls, Pa.*

Circle **409** on Time-Saver Card

Holds Precise Adjustment - Won't Stick Open

RESTRICTOR VALVE



- **DEPENDABLE — no close sliding fits**
- **STRONG — all steel**

Write for detailed literature

- For Oil — up to 3,000 psi
- Sizes — ¼, ⅜, ½ & ¾ pipe (NPTF) — in stock

Manufacturers of Hydraulic Valves and Devices

Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

Fluid Controls, inc.

1284 N. CENTER STREET • MENTOR, OHIO

Member of National Fluid Power Association

Circle **49** on Time-Saver Card

MUNRAY AIR HOSE

- Non-Collapsible under vacuum
- Resistant to oils and greases
- Resists abrasion
- Resists corrosive atmospheres
- Rated to 125 psi operating pressure
- You can't buy better air hose at any price

Call or write today for literature and prices

MUNRAY PRODUCTS, INC.

12402 CROSSBURN AVE.
CLEVELAND 35, OHIO
Phone: WI 1-0680

PLASTIC EXTRUDED SHAPES, PROFILES & TUBINGS — PROTECTIVE COATINGS — PLASTISOLS, SPECIAL MILLED COMPOUNDS

Circle **86** on Time-Saver Card

O-SEAL FITTINGS

O-seal fittings for any type of high-pressure piping system. O-ring inserts in machined groove. Fluid pressure gives positive sealing. Requires only light to moderate tightening. Fittings adaptable for installation in threaded pipe, welded, or brazed piping systems. Catalog 59 contains drawings and dimensions of check, relief, and globe and angle valves, valve spacers, nuts, tailpieces, threaded pieces, adapters, plugs, reducers, and reducing inserts. All components available in all standard pipe sizes from ¼" to 2". *Combination Pump Valve Co., Philadelphia, Pa.*

Circle **410** on Time-Saver Card

INDUSTRIAL CATALOG

Sixty-page catalog covers original manufacture and maintenance

equipment for various industries. Includes section on hydraulics. Contains specifications, drawings, and suggested uses. *Groban Supply Co., Chicago, Ill.*

Circle **411** on Time-Saver Card

CONTROL VALVES

Hydraulic control valves for heavy-duty mobile equipment have low pressure drop. Valves have open center, series parallel circuit, with integral individual load check valve for each cylinder port. Machined for SAE split flange port connections. Operating pressure to 2000 psi. 150 gpm nominal capacity. Catalog files 1553-A72, A73 describe 2, 3-spool versions. *Parker-Hannifin Corp., Cleveland, Ohio.*

Circle **412** on Time-Saver Card

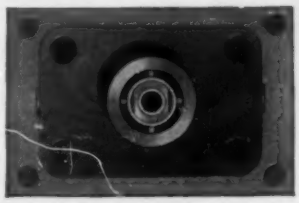
WELDED TUBING

Hydraulic fluid line tubing is cold drawn. In ¼"-1¼" diameter sizes. Wall thicknesses from 13 to 20 ga. Hydrostatically tested, oil coated. Bulletin includes complete engineering data. *Joseph T. Ryerson & Son, Inc., Chicago, Ill.*

Circle **413** on Time-Saver Card

YOUR BONUS from Pathon HYDRAULIC CYLINDERS

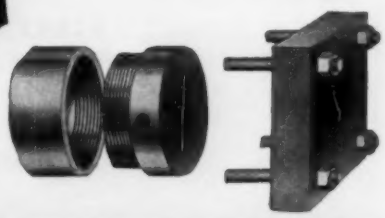
For the Designer



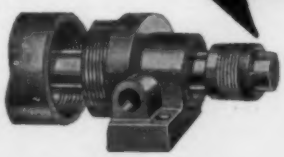
Pathon's compact design saves valuable space, makes your designing job easier, and gives your equipment that modern, rugged look.

For the User

Pathon's screw thread head design gives you up to 40% more strength than most tie-rod cylinders. This increased strength means less maintenance, and longer life.



For the Maintenance Man



Rod packing and bearing is externally replacable and any part can be replaced without complete disassembly and the resulting "basket full of parts".

FOR YOU

Let us give you a "Rod Column Effect" calculator. From this easy-to-use slide rule obtain optimum rod diameter for a given load and stroke.

Write for Calculator and Bulletin No. 22-A

Pathon MANUFACTURING COMPANY
3823 PACIFIC AVE. • CINCINNATI 12, OHIO

B-59

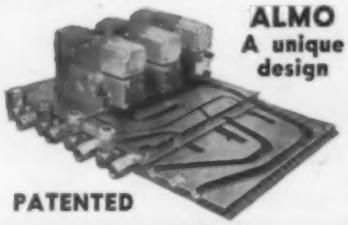
FLUID OPERATED AND CONTROL EQUIPMENT

Circle **93** on Time-Saver Card

Let us show you how ALMO construction can organize even the most complicated hydraulic circuit into a compact orderly panel

ALMO HYDRAULIC MANIFOLDS*

Rear of panel- Note take-offs directly to motors and cylinders. Valves, controls, junction box mount on panel.



ALMO
A unique design

PATENTED

Exposed lines are no longer necessary

★ Almo eliminates maze of piping, tubing, fittings

★ Built for heavy duty performance and pressures

★ Triple tested and unconditionally guaranteed

★ More efficient performance and better appearance for your product.

ENGINEERING RECOMMENDATIONS

ALMO
MANIFOLD & TOOL CO.
11470 Kaltz — Centerline, Mich.

Circle 11 on Time-Saver Card

POST SCRIPTS OF INDUSTRY

News about people, manufacturers and sales organizations

Maha succeeds Peterson as Hannifin Div. president

Maha

O. J. Maha succeeds Elwood G. Peterson as president and general manager of Hannifin Company Division, Parker-Hannifin Corporation. Maha was formerly Hannifin vice-president. Peterson will continue as a corporate vice president and director, specializing in corporate development.

Clippard names Smith executive v.-pres.

Ralph W. Smith has been appointed executive vice-president of Clippard Instrument Laboratory, Cincinnati, Ohio. Smith, with Coil Craft, Inc. for the past six years, will head all Clippard manufacturing and marketing.

Smith

Isaacs

Isaacs named zone sales manager by Wilkerson

Wilkerson Corporation, Englewood, Colorado, has appointed S. H. Isaacs as zone manager of southern Ohio, Indiana, and northern Kentucky. He was formerly sales vice-president of Industrial Engineering Corporation, Louisville, Kentucky. He is president of a pneumatics distributing firm, The Isaacs Company.

Barco expands in Canada

Barco Manufacturing Co., Barrington, Ill., has moved its Canadian plant from Walkerville to Windsor, Ontario. The new, bigger Windsor plant will house production of railroad, industrial, and construction tools, and can handle metalworking and molding jobs for American firms presently without Canadian facilities.

Holt to manage new division of Fawick

Holt

Fawick Corp., Cleveland, Ohio, manufacturer of industrial and automotive clutches and brakes, has established an hydraulic-electronic division. Fawick's recent acquisition of New Products Corp., Skokie, Ill., has put Fawick into the fluid valves and pumps field. Ray G. Holt, who will manage the new division, has held executive sales positions with Pesco Products and the Char-Lynn Co. Oscar H. Banker, formerly president of New Products, continues as R&D director of the new division.

Parker-Hannifin has new hose-assembly plant

A hose-assembly fabricating plant has been established in Des Plaines, Ill., by Parker Fittings & Hose Div., Parker-Hannifin Corp. The plant serves Illinois, Wisconsin, Minnesota, Iowa, Missouri, Nebraska, Kansas, Oklahoma, Colorado, and parts of Indiana and Michigan. Richard D. Moat, with Parker-Hannifin since January, is manager.

Continued on page 128

Circle **38** on Time-Saver Card

Designer's Fact File from DENISON

FLOW CONTROL

New infinitely-variable, Multi-Range Flow Control solves problem of uniform feed-rate on machine tools. Precision-built in three standard sizes—¼", ⅜", ¾"—for pressures to 3,000 psi. Features: Extra-sensitive flow selection. Simple, foolproof operation. Temperature compensated. Needs no external drain. Built to JIC Standards.

Write for full details in Bulletin VFC-3.

DENISON ENGINEERING DIVISION
American Brake Shoe Co.
1166 Dublin Road • Columbus 16, Ohio

HYDRAULIC PRESSES
PUMPS • MOTORS • CONTROLS

DENISON HydrOilics

Circle **105** on Time-Saver Card

SOLVES tooling and automation problems ECONOMICALLY!

$15.95
LIST
1" STROKE

IMPROVED!

1⅛" bore CLH SERIES clamp-type Hydraulic and Air Cylinders

The ideal cylinder for unlimited automation, tooling and production line applications where space and economy are important! Compact—only 1⅛" square. Pre-stressed construction for rough service. Double acting or spring return. Universal, clevis, or pivot mount. Rods and pistons hard chrome plated. Heads machined from square bar stock. Immediate delivery on 1", 2", and 3" strokes. Fractional or longer strokes available. 1500 psi hydraulic; 250 psi air.

Write NOW for NEW Bulletin No. 159

PNEUMATICS SHEFFER HYDRAULICS **THE SHEFFER CORPORATION**
Cincinnati 15, Ohio • Phone: VAlley 1-0320
Manufacturers of the industry's most complete line of air and hydraulic cylinders

SOLD BY LEADING DISTRIBUTORS NATIONWIDE

STAFFA

HIGH TORQUE VARIABLE SPEED (1-100 r.p.m.) HYDRAULIC MOTORS

Three Models now in production:
Mark III—5 cylinder 3,500 lbs. ft. at 1,500 p.s.i. (Speed 1-100 R.P.M.) **Mark IV**—5 cylinder 4,500 lbs. ft. at 2,000 p.s.i. (Speed 1-100 R.P.M.) **Mark V**—7 cylinder 6,600 lbs. ft. at 2,000 p.s.i. (Speed 1-75 R.P.M.) Overall efficiency 90% to 95%.
Ideal drive for conveyors, rolling mills, cranes, tractors, drills and most mechanical handling applications.

Ask for details of hydraulic cylinders, valves, pumps and motors.

CHAMBERLAIN INDUSTRIES LTD

Staffa Works, Staffa Rd., Leyton, London, E.10, England.
Leytonstone 3678
(Member of the Chamberlain Group of Companies)

Circle **30** on Time-Saver Card

Just Out! Just the ticket to cut cost!

NEW SPEED CONTROL VALVE

⅛" and ¼" pipe sizes in stock now!

Now a speed control valve that regulates your cylinder movement with precision and sureness, but which lists at $3.00 and $3.25. And despite its lower costs, "CUB" features the same high quality of design and workmanship you've come to expect from Ross. "CUB'S" design stresses trouble-free operation and easy maintenance. CUB is small, aluminum and lightweight. If you use speed controls, by all means call your Ross representative or write us.

ROSS OPERATING VALVE CO.
105 E. Golden Gate Ave. • Detroit 3, Michigan

Circle **103** on Time-Saver Card

POST SCRIPTS OF INDUSTRY

Andrews now pres. of Amer.-Standard Industrial Div.

Albert Andrews has been appointed president of the American Standard Industrial Division, Detroit, Mich. With American-Standard since 1950, he has been asst. secy. of the corporation, assistant to the president, vice-pres. of American-Standard Products (Canada), Ltd., and, most recently, vice-pres. and controller of the industrial division.

Titeflex fills three major posts

Titeflex, Inc., a subsidiary of Atlas Corp., Springfield, Mass., has announced three major appointments: E. M. Ramberg, v.-pres. of engineering for the past three years, will be v.-pres. of marketing. He will handle aircraft and commercial sales. Jay G. Oesterle, sales promotion manager since 1957, will be advertising

Ramberg

Oesterle

manager. George Derum will manage marketing for the commercial sales division. He has six years' management experience in the field.

Roper moves home office to Commerce, Georgia

The home office of Roper Hydraulics, Inc. has been moved from Rockford, Illinois to Commerce, Georgia, 60 miles northeast of Atlanta. The company is installing $250,000 worth of new machine tools to produce its line of positive displacement, gear pumps.

Bellows, Valvair, Sinclair-Collins to erect new plant

International Basic Economy Corporation's three fluid power divisions—The Bellows Co., Valvair Corp., and Sinclair-Collins Valve Co., all of Akron, Ohio—plan to erect a manufacturing and assembly plant on a five-acre plot in West Memphis, Ark. Initial construction of the brick, steel, and concrete plant will cover about 20,000 sq. ft. of floor space.

Bush now in Southwest sales for Standard Tube

Fred W. Bush is now an exclusive sales representative for the Standard Tube Co., Detroit, Mich. Bush, who will cover the Southwest for Standard, will maintain offices in Dallas, Tex. He will assist users of welded carbon and low alloy steel tubing, welded stainless steel pipe and tubing, and rigidized steel tubing. Bush was formerly president of Vinson Steel and Aluminum Co., and has had 25 years' association with the steel industry.

GRESEN HYDRAULICS

DOUBLE SELECTOR VALVE

Model DS-75

FEATURES: Cast iron body—chrome plated, pressure balanced spool—Easy to mount —Three optional handle positions.

SPECIFICATIONS: Capacity—24GPM @ 15 ft/sec.
Pressure range—0 to 1500 PSI
All openings—¾" NPT
Shipping weight—12 lbs.

WRITE FOR LITERATURE

GRESEN Mfg. Co.

405 35th Ave., N.E., Minneapolis 18, Minn.

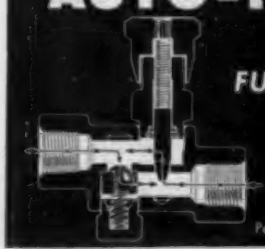
Circle 55 on Time-Saver Card

AUTO-PONENT®

HYDRAULIC FULL FLOW VALVES

Flow Control, Needle, Check, for HYDRAULIC Power

Model KF Flow Control Valve with Dial and Knob adjustment for direct reading and duplicating reference. Now available in Aluminum for 3000 psi.



Pat. #2,841,174

A complete line: ⅛", ¼", ⅜", ½", and ¾" female Dryseal Pipe Sizes in all models and types. Equivalent Aeronautical Tube Sizes on special order.

MINIMUM PRESSURE DROP AND POWER LOSS . . . Oversize ports and passages give maximum flow at minimum pressure drop, insure greater accuracy and response in hydraulic or large volume air cylinder control.

EASY FLOW ADJUSTMENTS under full pressure. Seal located at port to eliminate air or dirt traps. Gland structure equally effective on pressure or vacuum.

SENSITIVE, CHATTERLESS BALL CHECK . . . Patented design insures rapid ball movement to open or close at low differentials.

FORGED BODIES permit higher pressures with wide safety margins. Aluminum—3000 psi; Steel and Stainless Steel—5,000 psi. Pressure ratings based on better than 5 to 1 safety factor. All internal parts are Stainless. Write for illustrated catalog.

Model F Standard Flow Control Valve or Model N Needle Valve

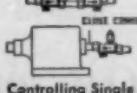
Model KF Knob and Dial Flow Control Valve or Model KN Needle Valve.

Model FF Knob and Dial Flow Control Valve or Model FN Needle Valve for panel mounting.

Model C Check Valve for In-Line Mounting.

TYPICAL APPLICATIONS

Controlling Double Action Cylinder



Controlling Single Acting Cylinder

AUTO PONENTS INC.

2919 GRANT STREET
BELLWOOD (Chicago Suburb) ILLINOIS

Circle 20 on Time-Saver Card

High Pressure Equip. Co. opens Cleveland sales office

McCracken

High Pressure Equipment Co., Erie, Pa., has opened a factory sales office in Cleveland, Ohio. Harry W. McCracken, formerly vice-president of Stanley M. Proctor Co., is in charge. The office will also serve H-P's client, W.C.T. Hart & Zn, Rotterdam, Holland, manufacturer of high pressure generation and measurement apparatus.

You give food and friendship with every $1 package you send to the world's hungry thru the CARE Food Crusade, New York

Bartlett named Moog engineering manager

George E. Bartlett has been named engineering manager for Moog Servocontrols, Inc., East Aurora, N. Y. He was formerly administrative engineer in Cornell Aeronautical Laboratory's Aerodynamics Research Department.

Bartlett

Evans

Evans appointed v.-pres. of Universal Hydraulics

Barry Evans has been appointed vice-president—engineering and sales of Universal Hydraulics Division, Holan Corp., Cleveland, Ohio. Evans comes to UH from Hydreco Division, New York Air Brake Co., Kalamazoo, Mich., for whom he was manager of parts and service.

New distributors

Hersh Packing & Rubber Co., Canal Winchester, Ohio, and *Milam Aircraft & Industrial Supply Co.*, Dallas, Texas, are now stocking distributors of valves and other hydraulic components made by Republic Manufacturing Co., of Cleveland, Ohio.

Racine-Chicago Engineering Corp., North Lake, Ill., will cover metropolitan Chicago and northern Indiana for Racine Hydraulics & Machinery, Inc., Racine, Wis.

Don E. Williams Co., Moline, Ill., will handle Wilkerson pneumatic and hydraulic components for factories in eastern Iowa and western Illinois.

ON THE JOB...

with CROSS HYDRAULIC CYLINDERS

Stay "on the job" with dependable, rugged Cross Hydraulic Cylinders. Like Cross customers everywhere, you too, will appreciate the fast, courteous, dependable service you get from Cross. Phone for speedy delivery on any quantity...quality-built to your specifications. Contact Cross Engineering Department, today!

- RUGGED
- DEPENDABLE
- ECONOMICAL

CUSTOM DESIGNED CYLINDERS FOR EVERY APPLICATION

Try CROSS CYLINDERS in your operation... low cost, dependable, and trouble free.

Lowest-Priced Engineered Quality Cylinders Available..

trade mark of Quality in Hydraulic Cylinders...

CROSS MANUFACTURING CO.
LEWIS, KANSAS – PHONE EA 4-5525

WRITE • WIRE • PHONE...TODAY!!

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APPLIED **Hydraulics & Pneumatics**

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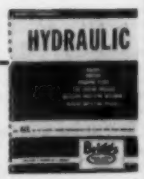

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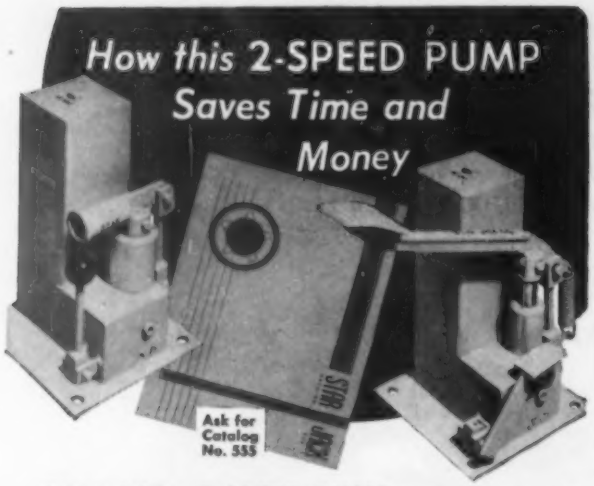

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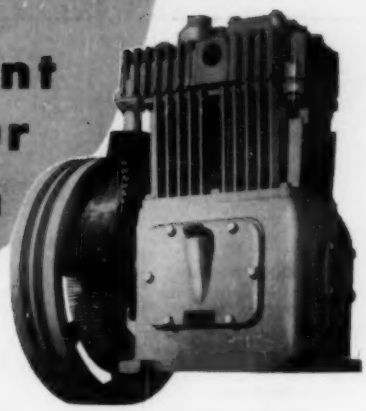

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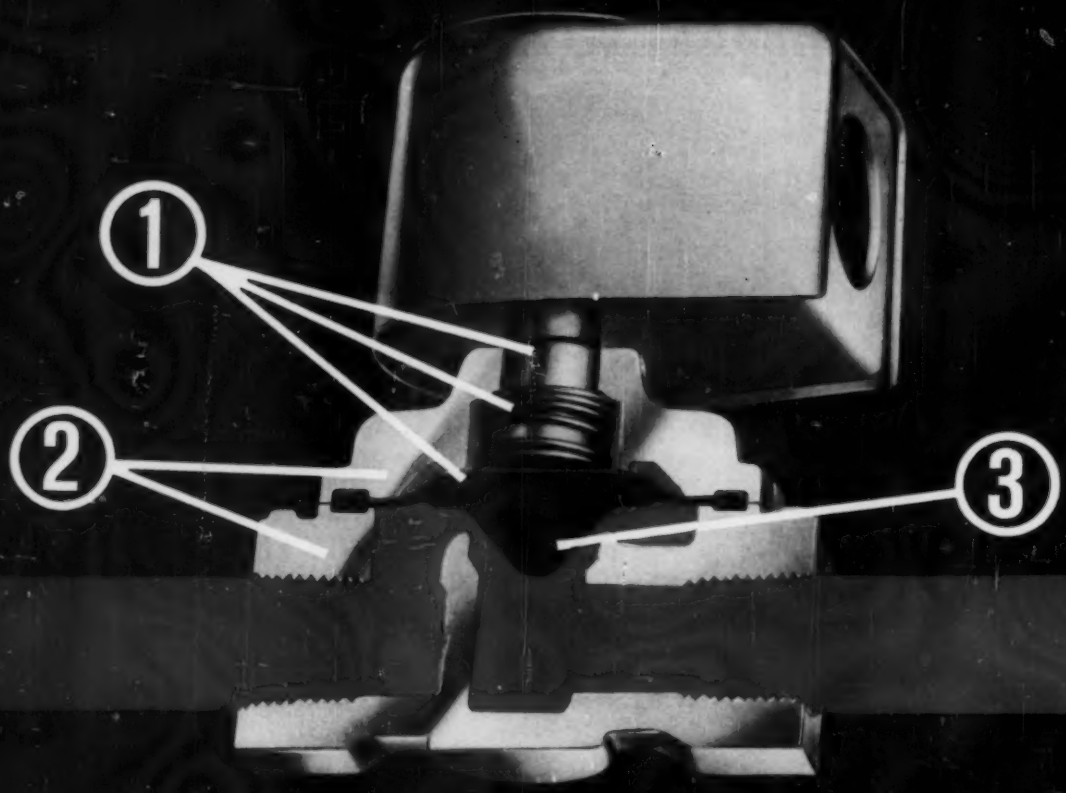

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